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NAVIGATION IMPROVEMENTS FOR BOSTON HARBOR, MASSACHUSETTS

COMMUNICATION

FROM

THE ACTING ASSISTANT SECRETARY (CIVIL WORKS), THE DEPARTMENT OF THE ARMY

TRANSMITTING

A REPORT ON THE AUTHORIZATION OF NAVIGATION IMPROVEMENTS FOR BOSTON HARBOR, MASSACHUSETTS, PURSUANT TO PUB. L. 104–303, SEC. 101(a)(13)

OCTOBER 21, 1997.—Referred to the Committee on Transportation and Infrastructure and ordered to be printed

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House Document No. 105-150 (105-1)

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U.S. GOVERNMENT PRINTING OFFICE

44–191 WASHINGTON : 1997

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LETTER OF TRANSMITTAL

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
CIVIL WORKS
108 ARMY PENTAGON
WASHINGTON DC 20310-0108

REPLY TO
ATTENTION OF

6 OCT 1997

Honorable Newt Gingrich
Speaker of the House
of Representatives
Washington, D.C. 20515

Dear Mr. Speaker:

Section 101(a)(13) of the Water Resources Development Act (WRDA) of 1990, authorized navigation improvements for Boston Harbor, Massachusetts. The Secretary of the Army supports the authorization and plans to implement the project through the normal budget process.

The views of the Commonwealth of Massachusetts, the Departments of the Interior and Commerce, and the Environmental Protection Agency are set forth in the enclosed report.

The plan recommended in the Report of the Chief of Engineers dated May 11, 1989, is hereby approved subject to the modifications made herein and described in the enclosed Limited Reevaluation Report dated June 1996. The original feasibility report did not identify a dredged material disposal plan because sediment testing had not been completed. That disposal plan has been completed and the Limited Reevaluation Report and the Final Environmental Impact Report/Statement dated June 1995, address the issues associated with the disposal of dredged material. In addition, the Limited Reevaluation Report also describes modifications to the project resulting from changes in the locations of benefitting facilities and from ship simulation studies. These modifications are for design purposes relating to provision of a safe and reliable navigation project. They can be accomplished under the authority provided to the Chief of Engineers through the authorization of the project in WRDA 1990. The modified project is the national economic development plan, and no separable fish and wildlife mitigation is required.

The modified project includes deepening the 1-mile-long Reserved Channel from 35 to 40 feet below mean low water (MLW) with the exception of its upper 1,340 feet which will remain at 35 feet below MLW. The width of the

Reserved Channel would be narrowed from 430 feet to 400 feet by deauthorizing a 15-foot-wide section along each side of the existing channel. The Reserved Channel width adjacent to the Conley Terminal would be reduced to 380 feet to accommodate new dock construction. The Reserved Channel would be widened at its confluence with the Main Ship Channel, and an area in the Main Ship Channel located opposite the Reserved Channel would be deepened from 35 feet to 40 feet below MLW to provide a maneuvering area for vessels navigating the Reserved Channel.

The existing 2-mile-long Chelsea River Channel would be deepened from 35 to 38 feet below MLW. The existing 1.25-mile-long Mystic River Channel would be deepened from 35 to 40 feet below MLW, except for an area at its upstream limit where the waterfront has been converted to non-navigation uses and where facilities do not require depths greater than 35 feet.

The modified project also includes deepening the Inner Confluence Area between the Mystic River Channel, Chelsea River Channel, and Main Ship Channel from 35 to 40 feet below MLW. An area along the East Boston waterfront would be deepened from 35 feet to 40 feet below MLW, and widened up to 300 feet to improve the approach for vessels navigating the Inner Confluence Area. The project also includes designating Federal channel limits for an area about 1,200-feet-wide by about 2.5-miles-long through the President Roads Ship Channel, thereby preventing the encroachment of vessels into the President Roads Anchorage. This will result in the enlargement of the existing deep-water anchorage from about 350 acres to about 420 acres. This does not require construction.

The modified plan includes the disposal of about 1.1 million cubic yards of silty maintenance material, which is unsuitable for unconfined open water disposal. This material would be disposed of within the navigation channel, below the authorized channel depth, and capped with acceptable material. Approximately 1.7 million cubic yards of remaining clean excavated materials will be disposed of at the Massachusetts Bay Disposal Site, an Environmental Protection Agency approved disposal site.

In addition, about 90,000 cubic yards of rock would be blasted and removed from the channel. Non-Federal interests would relocate utilities and deepen berthing areas.

Based on June 1996 price levels, the total first cost of the project is estimated at about $28,170,000. The Federal and non-Federal shares are estimated at about $16,820,000 and $11,350,000, respectively. The non-Federal share includes the additional 10 percent non-Federal share of the general navigation features required by Section 101 of the Water Resources Development Act of 1986, the cost of deepening berthing areas, and the cost of utility relocations.

Implementation of the project will be subject to certain non-Federal cost sharing, financing, and other applicable items of local cooperation described on pages 6 and 7 of the report of the Board of Engineers and Harbors. Implementation will be subject to additional items of local cooperation that would be referred to as items 16f, 16g, 16h, and 16i in the Board's Report. Specifically, the non-Federal sponsor shall:

"f. Perform, or cause to be performed, any investigations for hazardous substances as are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the construction, operation, maintenance, repair, replacement, or rehabilitation of the general navigation features. However, for lands that the Government determines to be subject to the navigation servitude, only the Government shall perform such investigation unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;"

"g. Assume complete financial responsibility, as between the Federal Government and the non-Federal sponsor, for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the construction, operation, maintenance, repair, replacement, and rehabilitation of the general navigation features;"

"h. To the maximum extent practicable, perform its obligations in a manner that will not cause liability to arise under CERCLA; and,"

"i. Prohibit erection of any structures or berthing of any vessels that would encroach on the authorized general navigation features."

The Office of Management and Budget advises that there is no objection to the submission of the report to the Congress. The project, as modified by the Secretary of the Army, is consistent with the program of the President. A copy of their letter is enclosed in the report.

Sincerely,

John H. Zirschky
Acting Assistant Secretary of the Army
(Civil Works)

Enclosure

COMMENTS OF THE OFFICE OF MANAGEMENT AND BUDGET

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

JUN 2 1997

The Honorable H. Martin Lancaster
Assistant Secretary of the
Army for Civil Works
Pentagon - Room 2E570
Washington, D.C. 20310-0108

Dear Mr. Lancaster:

We have completed our review of the following projects, as required by Executive Order 12322:

- Boston Harbor, Massachusetts, by letter of September 20, 1996;
- Blue River Basin, Dodson Industrial Area, Kansas City, Missouri, by letter of October 14, 1996;
- Charleston Harbor, South Carolina, by letter of July 19, 1996;
- Clifton, Arkansas, by letter of June 12, 1996;
- Columbia River Treaty Fishing Access Sites -- Phase II, by letter of July 23, 1996;
- Long Beach Island, New York, by letter of April 30, 1996;
- Lower Savannah River, South Carolina, by letter of September 17, 1996.

Our review concluded that your recommendations for these projects are consistent with the policies and program of the President. The Office of Management and Budget does not object to your submitting these reports to Congress.

We note that these projects have been at OMB for review beyond our normal review time. We regret any difficulties that this extended review time might have created. We are taking steps to improve the timeliness of these reviews to help the Corps and the local sponsors.

Sincerely,

T.J. Glauthier
Associate Director
Natural Resources,
Energy and Science

COMMENTS OF THE COMMONWEALTH OF MASSACHUSETTS

THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS

MICHAEL S DUKAKIS
GOVERNOR

JOHN DEVILLARS
SECRETARY

March 30, 1989

Lieutenant General H.J. Hatch
Chief of Engineers
ATTN: CECW-P
Department of the Army
Washington, D.C. 20314-1000

Dear General Hatch:

In response to your letter of October 27, 1988, The Executive office of Environmental Affairs of the Commonwealth of Massachusetts supports the continued planning, engineering, and environmental analysis for the proposed Boston Harbor Navigation Improvement Project. While we have serious reservations about the project, particularly the potential adverse environmental impacts associated with the dredging and disposal of the dredged materials associated with the project, we believe that the continued study is not only warranted, but necessary.

However, our support for the continued study of this project should not be construed, in any way, to obligate the Executive Office of Environmental Affairs to funding any aspect of this project. It must also be clearly understood that this letter in no way represents a concurrence with the findings of the Boston Harbor Navigation Improvement Study Feasibility Report and Environmental Assessment. Indeed, we have expressed reservations about certain conclusions reached in that Report. It is our hope that the continued study of this project will provide the sufficient information to allow our full and complete support for the project.

Should you require any additional information or further clarification of our position, please contact Brad Barr of my Coastal Zone Management staff at (617) 727-9530.

Sincerely,

John P. DeVillars
Secretary

JPD/BWB
cc: Governor Michael S. Dukakis
Col. Daniel M. Wilson, Division Engineer, New England Division
John M. McCann, Jr., Acting Resident Member, Board of Engineers for Rivers and Harbors

'SPORT, TEN PARK PLAZA, BOSTON, MA 02116-3971, (617) 973-5500 TELEX 94-0365

March 14, 1989

23 MAR RECD

Department of the Army
Board of Engineers for Rivers and Harbors
Kingman Building
Fort Belvoir, VA 22060-5576

Dear Mr. McCann:

Thank you for sending the Massachusetts Port Authority copies of the proposed report of the Chief of Engineers and the report of the Board of Engineers for Rivers and Harbors on Boston Harbor, Massachusetts.

We have reviewed the report, agree with it and encourage that it be implemented.

We compliment the Corps and particularly the New England Division for their work on this important project and we look forward to its construction.

Sincerely,
MASSACHUSETTS PORT AUTHORITY

David W. Davis
Executive Director

DWD/mcd
0098

COMMENTS OF THE DEPARTMENT OF THE INTERIOR

United States Department of the Interior

OFFICE OF ENVIRONMENTAL PROJECT REVIEW
WASHINGTON, D.C. 20240

January 6, 1989

ER 88/950

Lieutenant General H. J. Hatch
Chief of Engineers
ATTN: CECW-PM
Department of the Army
Washington, D.C. 20314-1000

Dear General Hatch:

The Department of the Interior has reviewed your proposed report and other pertinent reports for Navigation Improvements, Boston Harbor, Massachusetts. We have the following comments and recommendations.

Our Fish and Wildlife Service (FWS) has provided comments to the Corps by letters dated August 20, 1987, May 11, 1988, and August 12, 1988, on the Boston Harbor Navigation study. The major unresolved concerns raised by those letters involve: (1) the absence of information regarding the quality of recently deposited (maintenance type) dredged materials within the harbor, (2) the proposal to dispose all of the dredged material from the project at the Foul Area or other open water sites; and (3) the environmental impact of the proposed action.

The Corps proposes to dredge approximately 2.1 million cubic yards of fine grained unconsolidated sediment, clay and ledge rock from the various Boston Harbor channels. This material would be disposed in deep water at the Foul Area in Massachusetts Bay. Water depths at this disposal site are approximately 300 feet.

The Corps has decided not to conduct bioassay, bioaccumulation, priority pollutant, and non-conventional pollutant tests to determine the true nature of the dredged material until after the project has been authorized by the Congress. We disagree with the Corps' approach to evaluating the environmental effects of the proposed dredging and disposal work without having first collected the basic chemical and biological data on the sediments proposed for dredging. At this time, there appears to be little, if any, data to support the Corps' proposal to use the Foul Area as the disposal site for Boston Harbor dredged material. In order for Congress and other interested parties to make a reasoned decision on the potential environmental effects of the proposed action, the additional data should be provided prior to seeking Congressional authorization.

The Corps' proposal to use the Foul Area as the sole disposal site is presently under review by the Environmental Protection Agency (EPA). The Foul Area currently has an interim use designation, and EPA is considering whether or not to designate the area as a dredged material disposal site. If approval is granted for this site or elsewhere, EPA

could require use restrictions that could have significant bearing on any subsequent dredged material disposal by the Corps for this navigation project. In addition, the Corps could be required to identify confined disposal sites for contaminated dredged material disposal. Presently, no such sites exist in the Boston Harbor area.

In summary, we disagree with the Corps' environmental assessment and finding of no significant impact for the Boston Harbor Project. We disagree with the finding because the types, concentrations, locations, and impacts of chemicals known to be present in the project area have been inadequately addressed. In addition, the Corps has not undertaken chronic and acute toxicity studies on sensitive species nor have short- and long-term bioaccumulation studies been completed using appropriate test species. Hence, the Corps appears to have no substantive basis for concluding that significant project related impacts would not occur.

We recommend that you reconsider your proposed report in light of these unresolved concerns and not forward it to the Secretary of the Army until you have the needed data to support disposal at the Foul Area or any other disposal site.

Sincerely,

Bruce Blanchard, Director

COMMENTS OF THE ENVIRONMENTAL PROTECTION AGENCY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203-2211

January 4, 1989

Lieutenant General H. J. Hatch
Chief of Engineers
Department of the Army
Washington, D.C. 20314-1000

ATTN: CECW-P

Dear Lieutenant General Hatch:

The EPA Region 1 Wetland Protection Section has reviewed the Navigation Improvement Study, Feasibility Report and Environmental Assessment for Boston Harbor, Massachusetts prepared by the Corps New England Division.

The Corps proposes to deepen the existing Federal navigation projects to 40 feet in the Mystic River and Reserved Channel and to 38 feet in the Chelsea River. We previously met with the New England Division to discuss this project. While we agree in concept with the plans, we cannot at this time determine the acceptability of the proposed dredged material for disposal at the Foul Area Disposal Site (FADS).

The tests required by section 103 of the Marine Protection Research and Sanctuaries Act have been postponed until the preconstruction engineering and design phase of the study. We concurred with the Corps plan to do the testing at this later phase, and assume that the testing will follow the protocol described in the latest draft of the "Green Book" as discussed at the EPA/Corps meeting held last November in Cape May, New Jersey. We will provide additional comments to the Corps concerning the proposed disposal at FADS after the testing is performed and we receive the results.

Please call Edward Reiner of my staff at (617) 565-4434 for further coordination in this matter.

Sincerely,

Ronald G. Manfredonia, Chief
Water Quality Branch

cc: S. Mello, NMFS, Woods Hole, MA
L. Eaton, USFWS, Concord, NH
J. O'Connell, MCZM, Boston, MA
NEDACE, Navigation Section, Waltham, MA

COMMENTS OF THE DEPARTMENT OF TRANSPORTATION

US Department of Transportation
United States Coast Guard

Commandant
United States Coast Guard

Washington, D.C. 20593-0001
Staff Symbol: G-CPP-1
Phone: (202) 267-0389

0109 4142J

JAN - 6 1989

Lieutenant General H. J. Hatch
Chief of Engineers
Attn: CECW-P
Department of the Army
Washington, D. C. 20314-1000

Dear General Hatch:

We have reviewed the proposed report to Congress, and other pertinent reports, on the Navigation Improvement Study, Feasibility Report and Environmental Assessment - Boston Harbor, Massachusetts.

The recommendation to deepen the Chelsea River to a depth of -38 feet MLW is a change from the original recommendation of -40 feet MLW (put forth by the Army Corps of Engineers, New England Division in their draft Feasibility Report dated May 1988). However, our comments (enclosure (1)) submitted in response to the draft report are still applicable.

Thank you for providing us the opportunity to review the proposed report of the Chief of Engineers and other pertinent reports on Boston Harbor, Massachusetts.

Sincerely,

J. E. Lindak

J. E. LINDAK
By direction

Encl: (1) USCG Response to Draft Feasibility Rpt

Copy: CO, MSO Boston

U.S. Department of Transportation
United States Coast Guard

Commanding Officer
U.S. Coast Guard
Marine Safety Office

437 Commercial Street
Boston, MA 02109-1096
Phone: (617)565-9000
FTS 835-9003

16600
APR 25 1988

U.S. Army Corps of Engineers, New England Division
Coastal Development Branch, Bldg 114 South
424 Trapelo Road
Waltham, MA 02254-9149

Dear Mr. Habel:

I have reviewed your Draft Feasibility Report For Navigation Improvements In Boston Harbor dated February 25, 1988 and offer the following comments:

Presently, a permanent Captain of the Port Safety Zone exists as per 33 CFR 165.120 to control vessel movement in the vicinity of the Chelsea Street Bridge in the Chelsea River. These regulations were designed to protect vessels and the Chelsea Street Bridge structure. Accordingly, to ensure safety, there are restrictions imposed on the size of vessels allowed to transit through this Safety Zone. The duration of this Safety Zone is uncertain due to the physical limitations of the bridge itself and its present state of disrepair.

In view of the above, deeper draft and larger sized vessels which could transit the Chelsea River upon dredging to -40 feet MLW will still be restricted from doing so because of the prevailing Safety Zone focused around the Chelsea Street Bridge. This limiting factor may directly impact the economic benefits obtained from deepening the Chelsea River. I therefore urge you to consult with the City of Boston regarding their future plans for modification of the Chelsea Street Bridge as this appears to be a critical issue.

If I can be of further assistance on this matter, please contact LT CORBIN of my staff at the above address or phone number.

Sincerely,

R. L. ANDERSON
Captain, U.S. Coast Guard
Captain of the Port

Copy: Commander, First Coast Guard District (m); (obr); (oan)
Boston Harbor Pilots

ENCLOSURE( )

BOSTON HARBOR, MASSACHUSETTS

REPORT OF THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314-1000

REPLY TO
ATTENTION OF:

11 MAY 1989

CECW-PE (10-1-7A)

SUBJECT: Boston Harbor, Massachusetts

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report on Boston Harbor, Massachusetts. It is accompanied by the reports of the Board of Engineers for Rivers and Harbors and the division engineer. These reports are in final response to resolutions of the Committee on Public Works of the United States Senate dated 1 March 1968 and 11 September 1969 which requested the Board of Engineers for Rivers and Harbors to determine the advisability of modifying the existing projects for Boston Harbor and Mystic River.

2. The division engineer recommends authorization of a plan of improvement for deep-draft navigation. The plan would include deepening the existing Federal navigation projects to 40 feet in the Mystic River and Reserved Channel and to 38 feet in the Chelsea River. Specific Federal channel limits would be declared through President Roads to connect the three entrance channels at the outer confluence with the Main Ship Channel, thereby establishing an enlarged President Roads Anchorage of about 420 acres. The recommended plan is the national economic development plan.

3. The Board of Engineers for Rivers and Harbors concurs in the findings and recommendations of the reporting officer. The recommended improvements are economically justified, engineeringly feasible, and environmentally acceptable. Based on October 1988 price levels, the first cost of the proposed project is estimated at $25,200,000 with a non-Federal share of $9,590,000. Average annual costs, based on an interest rate of 8 7/8 percent and a 50-year period for economic analysis, are $2,420,000. Average annual benefits are estimated at $4,258,000 and the benefit-cost ratio is 1.8. The board recommends that deep-draft navigation improvements for Boston Harbor and Mystic River, Massachusetts, be authorized for Federal implementation in accordance with the reporting officer's recommended plan and subject to cost-sharing, financing, and other requirements of Public Law 99-662 for projects of this kind and as otherwise required by law.

4. I concur in the findings, conclusions, and recommendations of the board.

5. The recommendations contained herein reflect policies governing formulation of individual projects and information available at this time. They do not necessarily reflect program and budgeting priorities inherent in the local and State programs or the formulation of a national civil works construction program. Consequently, I acknowledge that the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the State, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

H. J. HATCH
Lieutenant General, USA
Chief of Engineers

DEPARTMENT OF THE ARMY
BOARD OF ENGINEERS FOR RIVERS AND HARBORS
KINGMAN BUILDING
FORT BELVOIR, VIRGINIA 22060-5576

REPLY TO
ATTENTION OF:

CEBRH-PL (10-1-7a) 21 September 1988

SUBJECT: Boston Harbor, Massachusetts

Chief of Engineers
Department of the Army
Washington, DC 20314-1000

SUMMARY OF BOARD ACTION

The board finds that modifications for deep-draft navigation at Boston Harbor and the Mystic River, Massachusetts, are economically justified and environmentally and socially acceptable. Proposed improvements include deepening of the existing Federal navigation project to 40 feet in the Mystic River and Reserved Channel and to 38 feet in the Chelsea River. The plan also provides for enlarging the existing President Roads Anchorage area through boundary changes. The proposed plan involves dredging berthing areas, relocation of utilities, and disposal of dredged material at an approved site in Massachusetts Bay. The plan would provide safe navigation and more efficient utilization of vessels by permitting them to load to greater draft and reduce delays in waiting for favorable tides. The first cost of the proposed plan is estimated at $24,990,000, based on August 1988 price levels, and the benefit-cost ratio is 1.8.

SUMMARY OF REPORT UNDER REVIEW

1. AUTHORITY. This report is in final response to resolutions adopted 1 March 1968 and 11 September 1969 by the Committee on Public Works of the United States Senate. The committee requested the Board of Engineers for Rivers and Harbors to determine the advisability of modifying the existing projects for Boston Harbor and the Mystic River. The resolutions are quoted in the division engineer's report.

2. DESCRIPTION OF THE STUDY AREA

a. The Port of Boston is located on the western side of Massachusetts Bay approximately 50 nautical miles northwest of the tip of Cape Cod. It is the largest port in New England covering approximately 47 square miles and is one of the United States oldest and most historic international trading centers. A source of jobs and commerce for the 13 million residents of the six-State New England region, the port annually handles about

25 million tons of cargo worth more than $7 billion. Of the tonnages handled in 1986, approximately 91 percent was liquid petroleum products and the remaining 9 percent was non-petroleum bulk, containerized, and non-bulk cargo.

b. The U.S. Army Corps of Engineers has constructed navigation channels in Boston Harbor. Deepwater access from the Atlantic Ocean is provided by three entrance channels: the Broad Sound North Channel with two lanes at depths of 35 and 40 feet below mean low water (MLW); the 30-foot-deep MLW Broad Sound South Channel; and the 27-foot-deep MLW Narrows Channel. The entrance channels converge in the naturally deep President Roads area where there is an anchorage of approximately 350 acres. Other deep-draft navigation projects serve facilities presently based along the Main Ship Channel and three major tributaries. The Main Ship Channel extends from President Roads to the interior of the harbor and has two lanes with depths of 35 and 40 feet. Each lane is 600 feet wide. The three major tributary channels are the Reserved Channel and the Mystic and Chelsea Rivers. The Reserved Channel is 1 mile long and 430 feet wide. The Mystic River Channel is 6,500 feet long and varies in width from 580 to 1,060 feet. The Chelsea River channel is 2 miles long and varies in width from 225 to 430 feet. All the tributary channels have been improved to a depth of 35 feet.

3. PROBLEMS AND NEEDS. Vessels that make up the world fleet continue to increase in size. However, the transportation economies of using these larger vessels cannot be fully obtained for ships calling at Boston Harbor due to the restrictive channel depths and bends. The operating efficiency of large, deep-draft vessels is reduced when ships must wait for high tide (average 9.4 feet tide range) to transit harbor channels. There is a need to deepen channels to better accommodate the large ships presently using the harbor and those expected to use it in the future. Deepening the present channels is somewhat restricted by the stability of existing bulkheads and the need for berthing areas. In some locations, these restrictions will require that existing channels be narrowed as a part of any deepening. The restricted size of the President Roads Anchorage area is also a problem.

4. PROPOSED PLAN OF IMPROVEMENT. The district engineer's selected plan, based on one-way navigation of ships, provides for modification of the existing projects for Boston Harbor and Mystic River as follows:

a. Deepening the Reserved Channel to 40 feet MLW with the exception of its upper 1,340 feet which will remain at 35 feet MLW; reducing the width of the Reserved Channel to 400 feet by

deauthorization of 15 feet along each side of the channel; widening the Reserved Channel at its confluence with the Main Ship Channel to a maximum of about 1,200 feet to provide a maneuvering area and deepening that area to 40 feet MLW;

b. Deepening to 40 feet MLW the existing 35-foot-deep MLW inner harbor confluence area which connects channels in the Mystic and Chelsea Rivers with the Main Ship Channel, and widening the area along its eastern limit by up to 300 feet to provide maneuverability for larger vessels;

c. Deepening the Mystic River channel to 40 feet MLW except for that portion along the southern limit at the head of the channel from the Charlestown playground downstream to the former Shiavonne Wharf. The width of the channel to be deepened along the northern limit through this upstream reach would be 440 feet;

d. Deepening the existing Chelsea River channel to 38 feet MLW; and

e. Designating Federal channel limits 1,200 feet wide for about 2 1/2 miles through President Roads to connect the entrance channels at the outer confluence with the Main Ship Channel. Designation of channel limits would prevent encroachment of transiting vessels into the President Roads Anchorage area and would fix the size of the anchorage at 420 acres adjacent to the Main Ship Channel. This action would only require the relocation of several navigation buoys.

5. Non-Federal interests would relocate utilities and deepen berthing areas at the terminals of project beneficiaries. Adverse environmental impacts associated with the proposed improvements are not significant. Short-term disruption of the environment during dredging and disposal operations is expected. The selected plan would entail the removal of about 2 million cubic yards (yd^3) of dredged material. The material would be removed by bucket dredge and disposed of at the U.S. Environmental Protection Agency designated Foul Area Disposal Site (FADS) located in about 300 feet of water 18 miles east of Boston Harbor in Massachusetts Bay.

6. The recommended plan is the national economic development plan. Based on August 1988 price levels, the division engineer estimates the first cost of the plan to be $24,490,000 of which $9,650,000 would be non-Federal, including $1,527,000 for dredging berthing areas, and $130,000 for utility relocations. Average annual costs, based on an interest rate of 8 5/8 percent and a 50-year period for economic analysis are $2,331,000 including $104,000 for annual operation and maintenance. Average

annual benefits are estimated at $5,473,000, and the benefit-cost ratio is 2.3.

REVIEW BY THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS

7. GENERAL. The scope of the board's review encompassed the overall technical, economic, social, environmental, and policy aspects involved in the navigation improvements proposed by the reporting officer. The board considered the report's conformance with essential elements of the Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies and to other applicable administrative and legislative policies and guidelines. The board also considered the views of interested parties, including Federal, State, and local agencies, the Boston Harbor Pilots Association, and potential users of the improved channels.

8. RESPONSES TO DIVISION ENGINEER'S PUBLIC NOTICE. The division engineer issued a public notice on 23 May 1988 stating his findings and recommendations and inviting public comment to the board. The board received two letters in response to the notice. The letters, supporting the proposed improvement, were from an existing Boston Harbor channel user and the Boston Redevelopment Authority. The Redevelopment Authority provided comments dealing with environmental concerns.

9. FINDINGS AND CONCLUSIONS. The Board of Engineers for Rivers and Harbors generally concurs in the findings and recommendations of the reporting officer. The recommended channel improvements are economically justified, engineeringly feasible, and environmentally and socially acceptable. The proposed improvements would result in transportation savings and improved safety, and would make an important contribution to the economy and social well-being of Boston, the State of Massachusetts, the Port of Boston, and the Nation.

10. The reporting officer recommended deepening the Chelsea River portion of the project to 38 feet MLW. The proposed project may require additional protection for the existing Boston Gas Company's natural gas siphon in that area. The reporting officer intends to investigate this possibility during preconstruction engineering and design studies. In the event that protection is required to reduce erosion from vessel wakes, the reporting officer anticipates that a mat or cap of concrete or stone would be placed over the pipeline on the channel bottom. In an addendum to the report, he estimates the in-place cost for such protection at $500,000, which would be a non-Federal expense.

11. The board notes that some of the average annual benefits shown in the report are attributed to containership traffic. Those benefits have been based on reduction of both tidal delays and vessel lightloading. Subsequent to submittal of the report to the board, the reporting officer obtained additional and current information on containership service. This information is contained in the addendum to the report. Containership benefits at the Reserved Channel's Conley Terminal or the Mystic River's Moran Terminal will take the form of either tidal delay reductions or reduced lightloading requirements. Because of this uncertainty, the overall project benefit-cost ratio would range from 3.5 based on reduced lightloading to 1.8 based on tidal delay benefits. The tidal delay benefits are relatively small and, if eliminated, would only further change the benefit-cost ratio from 1.8 to 1.6. The savings in tidal delay are probabilistic in nature, subject to statistical analysis, and have been quantified on the basis of specific Boston Harbor tide patterns. The net impact of any further refinement of containership benefits would not adversely affect plan formulation or the justification of either separable project elements or the overall project. Due to the lack of documentation from the users for lightloading benefits, only tidal delay benefits for containerships and the resulting benefit-cost ratio of 1.8 can be supported at this time.

12. As a result of the added non-Federal cost to protect the pipeline, the total first cost of the proposed project is $24,990,000, including $630,000 for utility relocations and protection. Non-Federal costs would be $10,150,000. Average annual costs, based on an interest rate of 8 5/8 percent and a 50-year period for economic analysis, are $2,375,000 including $104,000 for annual operation and maintenance. Average annual benefits are estimated at $4,216,000 and the benefit-cost ratio is 1.8.

13. The board notes that the plan recommended by the division engineer is the one which maximizes net national economic development benefits, and that project benefits are based upon actual practices for underkeel clearances of vessels that operate in the Port of Boston. The plan complies with applicable policies and guidelines and the stipulated items of local cooperation are appropriate.

14. The reporting officer indicates that the project would not have any significant adverse environmental impacts and does not require separate fish and wildlife mitigation measures. On that basis, he prepared an environmental assessment in lieu of an environmental impact statement. The board concurs in this finding.

15. The board notes that the reporting officer has not yet completed coordination with the U.S. fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973. Normally, USACE policy requires that section 7 coordination be completed prior to submission of reports to a higher authority for approval. While USFWS and NMFS have agreed that dredging will not impact any threatened or endangered species, they have reserved final decision on the impact dredged material disposal might have on threatened or endangered species of whales and turtles at the Foul Area Disposal Site (FADS) until after the reporting officer has completed bioassay and bioaccumulation tests. For practical reasons, tests required by section 103 of the Marine Protection Research and Sanctuaries Act have been postponed until the preconstruction engineering and design (PED) phase of the study. The reporting officer indicates that there is a precedent for the quantity of material to be deposited at the FADS in that, during the period 1981-1984, material dredged from Boston Harbor during maintenance dredging was deposited at the site. The reporting officer also indicates that the sediments in the Mystic River (the most contaminated area of the proposed project) are similar in quality to materials recently dredged from that river by non-Federal interests. In two instances, both Federal and State permits were issued for disposal at the FADS. In addition, the reporting officer estimates that over 85 percent of the material to be dredged for the project is clean clay. Therefore, the reporting officer believes it is reasonable to assume that the material to be dredged will probably pass the section 103 bioassay and bioaccumulation testing. However, should some of the material fail the tests, the reporting officer has identified a contingency for its disposal. Under the plan, contaminated material would be dredged first and then capped at the FADS with uncontaminated clays. This procedure would isolate any of the contaminated material so that it would not adversely impact the biota. The board believes that performing the bioassay and bioaccumulation testing and completing the section 7 coordination during PED is justified and that postponement of these actions until that time would not have any irreversible impacts on endangered or threatened species.

16. The proposed plan would have a maximum channel depth of 40 feet MLW. Therefore, in accordance with the requirements of Public Law 99-662, non-Federal interests would be responsible for:

a. Providing during the period of construction, a cash contribution equal to 25 percent of the total cost of construction of the general navigation facilities;

b. Paying with interest, over a period not to exceed 30 years following completion of the project or separable element thereof, an additional 10 percent of the total cost of construction of general navigation facilities with credit for the value of lands, easements, rights-of-way, relocations (except for utility relocations), and borrow and dredged material disposal areas provided for construction;

c. Performing or assuring performance of all necessary alterations and relocations of pipelines, cables, and other utilities;

d. Providing to the Government all lands, easements, and rights-of-way, including suitable borrow and dredged material disposal areas, and performing all relocations or alterations of facilities other than utilities governed by paragraph c. above (except relocations or alterations of highway and railroad bridges) determined by the Government to be necessary for construction, operation, or maintenance of the project; and

e. Holding and saving the Government free from all damages arising from the construction, operation, and maintenance of the project, except for damages due to the fault or negligence of the Government or its contractors.

17. RECOMMENDATIONS. The board recommends that navigation improvements for Boston Harbor and Mystic River be authorized for Federal implementation generally in accordance with the reporting officer's recommended plan, with such modifications as in the discretion of the Chief of Engineers may be advisable. This recommendation is subject to cost sharing, financing, and other applicable requirements of Public Law 99-662, and as otherwise provided by law, and that the non-Federal sponsor agrees to provide, operate, and maintain at its own expense all project facilities other than those for general navigation, including deepening berthing areas and local access channels served by the proposed general navigation features to depths commensurate with those provided in the Federal channels.

18. The recommendations contained herein reflect the policies governing formulation of individual projects and the information available at this time. They do not necessarily reflect program and budgeting priorities inherent in the local and State programs or the formulation of a national civil works construction program. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the State, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

FOR THE BOARD:

GEORGE K. WITHERS, JR.
Major General, USA
Chairman

This report identifies changes to the authorized Boston Harbor Navigation Improvement Project that have taken place since the Feasibility report was completed in September 1988 (and the subsequent report of the Chief of Engineers dated 11 May 1989). The project was authorized for construction by the Water Resources Development Act of 1990. Project implementation has been delayed since 1989 primarily due to concerns about the dredging and disposal of contaminated (O&M) dredged material. The Feasibility Report did not identify a dredged material disposal plan because sediment testing had not been completed. This report and the Final Environmental Impact Report/Statement (FEIR/S) addresses all of the major issues that have been raised in developing an acceptable disposal plan.

Several major steps have been taken to respond to issues raised by those Federal agencies that provided comments to the report of the Chief of Engineers: Sediment testing and characterization, Ship Simulation studies, Acoustic Impedance surveys, biological studies, water quality modeling, preparation of a DEIR/S and a FEIR/S leading to selection of a dredged material disposal plan for both O&M and improvement project material.

Sediment Testing and Characterization

During the preparation of the Feasibility report, testing and characterization of dredged material was deferred in recognition of the development of a new national protocol. It was also decided that deferment would insure that test results would more accurately reflect the conditions at the time of testing. After receiving letters from the Department of the Interior (January 6, 1989) and the Environmental Protection Agency (January 4, 1989) in response to the Chief of Engineers Report, it was decided to accomplish sediment testing prior to initiating Preconstruction Engineering and Design (PED).

In 1990 dredged material in the project channels was evaluated in accordance with Section 103 of the Marine Protection, Research and Sanctuaries Act to determine the suitability for disposal at Massachusetts Bay Disposal Site (MBDS). Testing was performed using the procedures described in the draft national protocol ("Green Book") of January 1990 and draft regional protocol of May 1990. Generally the 1990 protocols which identified the specific physical, chemical and biological tests to be performed, were more sensitive than previously used tests making it more difficult to meet suitability requirements. Characterization followed in close coordination with EPA Region 1 resulting in a decision that all unconsolidated silt was unsuitable

for unconfined open water disposal and that all parent (improvement) material was suitable for open water disposal.

Environmental Issues

Subsequent to sediment characterization, disposal of unsuitable material became the major issue with Federal and State resource agencies. The proposed disposal of unsuitable material at the MBDS with capping using clean parent material was unacceptable to the EPA and other agencies.

Environmental Impact Report/Statement - Massport the non-Federal sponsor, initiated preparation of an Environmental Impact Report (EIR) in April 1991. NED decided in April 1992 to prepare an EIS based on cumulative impacts of Federal actions (maintenance, improvement and permit berth dredging) and to address significant public concern over the disposal of unsuitable material. The combined DEIR/S was completed in April 1994 and the FEIR/S was filed with EPA on 30 June 1995 (Federal Register). The comment period for the FEIS ended on 29 August 1995.

The FEIR/S selected plan is in-channel borrow pit disposal for unsuitable material from the channels (O&M) and berths and unconfined open water disposal at the designated MBDS for suitable material that is not allocated for beneficial use. With the exception of beneficial use by others, the disposal site for the suitable material has not changed from MBDS as proposed in the Feasibility Report.

Advisory Group - In addition to preparing an EIR, Massport formed an advisory group made up of 35 Federal and state agencies, local government, environmental groups and industry representatives. One subgroup advised on sediment testing and characterization for berth areas. Another subgroup developed disposal site screening criteria and ultimately assisted in the disposal plan selection process.

Environmental Compliance - The project has or will comply with all appropriate Federal and State and local environmental laws and regulations.

The DEIR/S discusses environmental compliance with Federal Statutes and Executive Orders, such as the Endangered Species Act, Fish and Wildlife Coordination Act, National Historic Preservation Act, Clean Air Act, Clean Water Act, and Coastal Zone Management Act, etc., in Section 5, pages 5-1 through 5-17. In addition this section details State and local environmental laws and regulations. A Clean Water Act Section 404 (b)(1) Evaluation is also included. The Corps and Massport jointly submitted an application for Water Quality Certification on 25 April 1996.

The FEIR/S describes the local, State and Federal regulations and how this project will comply with them. Section 8 discusses a draft Section 61 Findings. The Section

61 Findings is required as part of the Massachusetts Environmental Policy Act (MEPA) process.

The U.S. Fish and Wildlife Service is a cooperating agency for this EIS and has been fully involved in the development of the preferred alternative. The U.S. Fish and Wildlife Service has never determined that their August 12, 1988 FWCAR for the improvement project is inadequate. The June 17, 1994 letter from the U.S. Fish and Wildlife Service on the DEIR/S state that they are commenting in accordance with the Fish and Wildlife Coordination Act. The Corps does not obtain a FWCAR for maintenance dredging projects. The EIR/S concerns relate to the contaminated maintenance material of this project.

The DEIR/S, in Section 5, states that compliance with the Clean Air Act was realized with the release of the public notice for this project. No significant air quality impacts are expected from this dredging and disposal project, as was stated in the DEIR/S and FEIR/S. This project will occur in a large commercial harbor surrounded by downtown Boston and surrounding cities. Impacts from this project would be insignificant in comparison to background levels of air pollutants. The letter from the U.S. EPA on the DEIR/S or the FEIR/S does not indicate a concern with the Clean Air Act , or a disagreement with our determination. In addition, comments from the Commonwealth of Massachusetts do not address any concerns with air quality impacts.

State and Agency Review of EIR/S - Seventy one letters of comment on the DEIR/S were received and are included, with responses, in Volume 2 of the FEIR/S. Numerous investigations were accomplished including finfish, lobster and benthic studies at each potential disposal site and water quality modeling studies to determine impacts of dredging and disposal operations at each potential site. The advisory group was informed during each step of these studies.

Twenty comment letters were received in response to the FEIR/S. In general, the letters were positive and supported the preferred alternative. Comments and responses for Federal and State agencies are included in Attachment 1 to this report. The U.S. EPA agreed that the in-channel disposal alternative (preferred alternative) was the least damaging practicable alternative (LEDPA). The State also agreed with the preferred alternative, with some additional minor issues to be resolved. These issues will be discussed in greater detail during the permitting phase of the project. The National Marine Fisheries Service does not disagree with the preferred alternative, but would like to see additional biological sampling. The U.S. Fish and Wildlife Service believes the in-channel disposal alternative is reasonable but does not consider this alternative the LEDPA site.

Coordination with Agencies after the FEIR/S Comment Period - Further coordination with the agencies took place during the period of December 1995 through April 1996 to resolve remaining issues from the FEIR/S comment letters and to prepare the application for water quality certification and CZM consistency. Letters were requested from appropriate State agencies to indicate the likelihood of obtaining the necessary permits. The reply letters from both the Mass. Dept. of Environmental Protection (28 Dec. 1995) and the Mass. Coastal Zone Management Office (28 Dec. 1995) are included in Attachment 2-A to this report and indicated their expectation to issue the permits.

During this same period eleven issues from the FEIR/S comment letters were identified that require resolution during the permit phase of the project. Coordination with the commenting agencies resulted in letters from the agencies that give assurances that the issues have been or will be resolved in a way satisfactory to the Corps and the appropriate agencies during the permit process. A summary of the issues, the responses and letters of concurrence from the agencies are included in Attachment 2.

Future Maintenance and Disposal Issues - New England Division is committed to providing appropriate resources to address the long-term needs for the region for disposal of contaminated sediment. NED has conducted Section 22 studies to begin to identify the need and issues on this topic. We will continue to provide support, along with the Commonwealth of Massachusetts (and other states), U.S. EPA, and other appropriate agencies to address this question.

In particular, the EIR/S narrows the large list of disposal alternatives to a short tiered list of preferred disposal alternatives. The in-channel alternative is the preferred alternative for this project. The remaining disposal alternatives on the short list may be suitable for future maintenance dredged material. A NEPA document (EA or EIS) would be prepared for the disposal of future maintenance material. This would involve coordination with other agencies.

Sponsor Support

Massport has expended significant resources in the preparation of the EIR/S and related studies. Their strong support also includes participation in introducing state legislation to fund major port improvements in Massachusetts, including the funds required for the Boston Harbor Navigation Improvement Project.

Project Channel Limits

The authorized project limits have changed due to location of beneficiary berth areas and from ship simulation studies completed in December, 1992. No changes have been made to the authorized depths of the project channels except for two

areas of the Main Ship channel required for safe maneuvering. A plan of the current project is attached. The current project description follows with a summary of changes made since the Feasibility Report.

Reserved Channel - Narrow the 35-foot channel from 430 to 400 feet and 380 feet wide (at Conley Terminal), widen the channel at its confluence with the Main Ship Channel, and deepen the channel to 40 feet, except for its upper 1,340 feet which would remain at 35 feet. Deepen a portion of the 35-foot main ship channel to 40-feet opposite the Reserved Channel to provide turning area.

Ship simulation results indicated that the turning area at the mouth of the Reserved Channel proposed in the Feasibility Report may be changed to reduce rock excavation and still satisfy the recommendations of harbor pilots who participated in the simulation. These changes were incorporated. Other changes include a reduction the area to be deepened lying north of the mouth of the channel and to provide additional turning area by deepening the 35-foot Main Ship Channel to 40 feet in a small reach opposite the mouth of the Reserved Channel. Also, the channel width adjacent to the Conley Terminal berth was reduced to 380 feet to accommodate new dock construction.

Chelsea River Channel - Deepening the existing 35-foot channel to 38 feet, and Non-Federal relocation and alteration of utility crossings beneath the channel.

No changes are proposed to the authorized project. NED is coordinating with the City of Boston and USCG on their plans to replace the Chelsea Street Bridge which currently restricts vessel traffic.

Mystic River Project - Deepen the existing 35-foot channel to 40 feet, except for an area at the upstream limit along the southern shoreline where the waterfront has been converted to non-navigation dependent uses and where existing users do not require depths greater than 35 feet.

The channel length was reduced. The last upstream berth (Boston Edison) will not be deepened since this beneficiary will receive petroleum from the Exxon berth further downstream. Also, ship simulation studies resulted in a more gradual transition from the wider downstream channel to the narrower upstream channel to provide a safer turning area.

Inner Confluence Area - Deepen the 35-foot confluence of the Mystic and Chelsea Rivers to 40 feet to enable deepening of the two river channels. Deepen a portion of the 35-foot Main Ship Channel to 40-feet along the East Boston waterfront for an approach to the Inner Confluence.

Ship Simulation results indicated two changes from the Feasibility Report plan.

A small area on the east side of the confluence, outside of the current project limits, was included in the authorized project to provide for a larger turning area. Ship Simulation studies indicated that this area was not required for safe maneuvering and it was eliminated. The simulation study also indicated the need for deepening an appropriate length of the 35-foot Main Ship channel leading into the Inner Confluence to 40 feet. This change is only to allow for continuation of wide turns from the 40-foot lane of the Main Ship channel into the Mystic River.

President Roads Ship Channel - Nonstructural designation and remarking of specific Federal channel limits along the southern reach of the Roads connecting the outer confluence of the three entrance channels with the Inner Harbor Main Ship Channel, resulting in a 20% enlargement of the deepwater anchorage to about 420 acres.

No changes are proposed to the authorized project.

Dredged Material Quantities

Subsequent to the feasibility report dredged material volumes and costs were reevaluated and maintenance material was separated from the improvement material. Studies using acoustic impedance technology and subsurface borings provided a more accurate estimate of rock quantities and confirmed material types. Changes to the project channel limits and depths described above also impacted quantities. The following table summarizes the quantities:

TABLE 1
Quantities of Dredged Material for Federal Channels
(in cubic yards)

Channel	Feasibility Report		Current Project	
	Ordinary Material	Rock	Ordinary Material	Rock
Reserved Channel	438,400	39,900	600,400	34,000
Mystic R. /Inner.Confl.	1,144,800	54,000	1,289,700	54,000
Chelsea River	455,200	-	557,400	-
TOTAL	2,038,400	93,900	2,447,500	88,000

Project Costs

Tables 2 and 3 are summaries of project costs and cost sharing for the Feasibility Report plan and the current project estimate:

TABLE 2
Navigation Improvement Project Costs
(in $000)

Account	Item	Feasibility Report June 96 P.L.	Current Project June 96 P.L.	Current Project fully funded
02	Relocations	830	980	1,020
12	Navigation Ports and Harbors	28,300	24,305	25,785
30	Plng., Eng., and Design	1,770	2,190	2,220
31	Construction Mgmt.	2,000	675	775
	Aids to Navigation (USCG)	20	20	20
TOTAL PROJECT COST		$32,920	$28,170	$29,820

TABLE 3
Cost Sharing and Benefit to Cost Ratio

	Feasibility Report (June 1996 PL, 8-7/8 %)	Current Project (June 1996 PL, 7-5/8%)
Total Project	$32,900,000	$28,170,000
Federal Cost	$22,530,000	$16,820,000
Non-Federal Cost	$10,370,000	$11,350,000
Annual Benefits:		
Comm. Navigation	$4,035,000	$3,595,000
Benefit to Cost Ratio	1.6 to 1	1.5 to 1

TABLE 4
Annual Benefits and Benefit/Cost Summary

	Annual Benefits	Annual Costs	BCR	Net Annual Benefits
President Roads (non-structural)	—	—	—	—
Reserved Channel	$1,404,000	$725,000	1.94	$679,000
Mystic River & Inner Confluence	$1,511,000	$1,134,000	1.33	$377,000
Chelsea River	$679,000	$493,000	1.38	$86,000
Total Project	$3,595,000	$2,352,000	1.5	$1,243,000

* Annual costs and benefits are based on March 1995 price level. Interest Rate = 7-5/8%

Project Benefits
Several minor changes in direct project beneficiaries have taken place since the Feasibility Report which have had only minor effect on the project. All benefits are Commercial Deep-Draft category. The following table lists current beneficiaries, reevaluated and confirmed by interviews in 1995 and changes since the Feasibility Report:

Reserved Channel:
Coastal Oil New England Inc.
shipping lines using Massport's Conley Container Terminal

Boston Edison was dropped because of switch over from oil to natural gas.

Mystic River Channel:
Exxon USA, Inc.
Distrigas of New England (LNG)
Prolerized (Scrap Metal Export)
Boston Edison (Petroleum for Power Generation)
shipping lines using Massport's Moran Container Terminal

No changes from the Feasibility Report

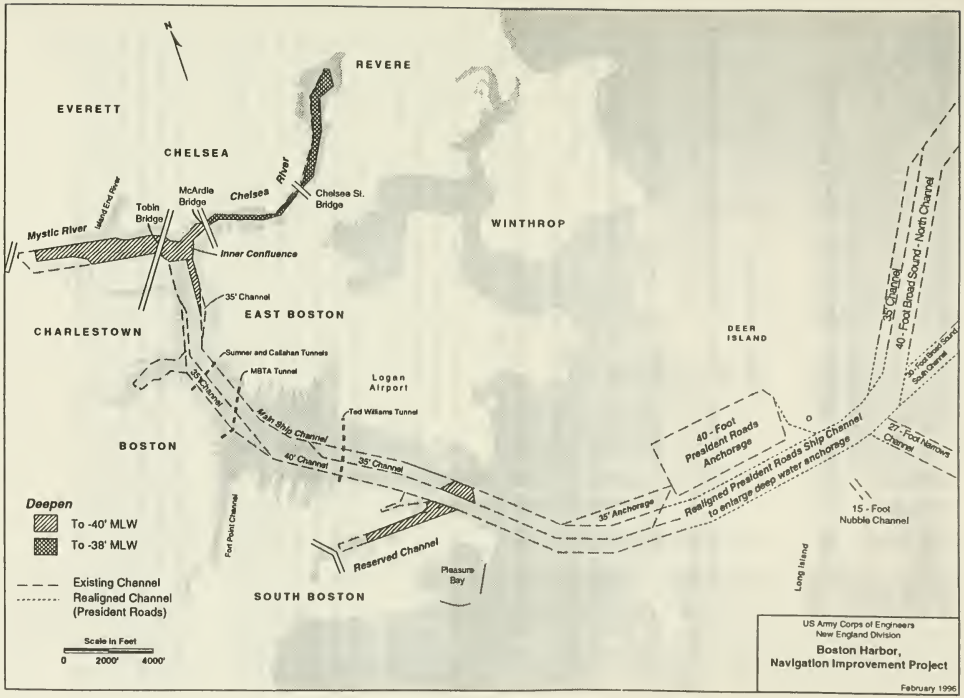
Chelsea River Channel:
Eastern Minerals
Northeast Petroleum
Gulf Oil Co.
Coastal Oil New England

Eastern Minerals was added
Mobil Oil was dropped (shift to barges)

Conclusion

Issues that have been raised concerning dredging in Boston Harbor have focused on the dredging and disposal of contaminated (O&M) material. All issues have been addressed through extensive data collection and analysis, close coordination with all interested Federal and state agencies and other through the advisory group and the formal EIR/S process.

The selected disposal plan for suitable and unsuitable material has been found acceptable to all participating Federal and State agencies and is supported by Massport.


N
REVERE
EVERETT
CHELSEA
Chelsea River
McArdle Bridge
Chelsea St. Bridge
Mystic River
Island End River
Tobin Bridge
Inner Confluence
WINTHROP
35' Channel
EAST BOSTON
CHARLESTOWN
Sumner and Callahan Tunnels
MBTA Tunnel
Logan Airport
Ted Williams Tunnel
DEER ISLAND
35' Channel
40 - Foot Broad Sound - North Channel
Broad Sound South Channel
BOSTON
Main Ship Channel
40' Channel
35' Channel
40 - Foot President Roads Anchorage
Realigned President Roads Ship Channel to enlarge deep water anchorage
27' Foot Narrows Channel
35' Anchorage
15 - Foot Nubble Channel
Deepen
To -40' MLW
To -38' MLW
Existing Channel
Realigned Channel (President Roads)
Fort Point Channel
Reserved Channel
Pleasure Bay
Long Island
SOUTH BOSTON
Scale in Feet
0
2000'
4000'
US Army Corps of Engineers
New England Division
Boston Harbor,
Navigation Improvement Project
February 1996

Attachment 1

Boston Harbor Navigation Improvement Project

Federal and State Agencies
Comments and responses from review of the Final EIR/S

Federal Agencies:

- U.S. Department of the Interior, Fish and Wildlife Service, New England Field Office, 11 August 1995

- U.S. Environmental Protection Agency, Region 1, 23 August 1995

- U.S. Department of Commerce, Office of the Under Secretary for Oceans and Atmosphere, 29 August 1995

Commonwealth of Massachusetts

- Executive Office of Environmental Affairs, (Certificate of the Secretary of Environmental Affairs), 14 September 1995

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Field Office
22 Bridge Street, Unit #1
Concord, New Hampshire 03301-4986

REF: 1992-00844

August 11, 1995

Colonel Earle C. Richardson
Division Engineer
U.S. Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham, MA 02254

Dear Colonel Richardson:

This is in response to your June 23, 1995 request for comments on the final environmental report (EIR/S) for the Boston Harbor Massachusetts Navigation Improvement and Berth Dredging Project. These comments are submitted in accordance with the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.) and the Clean Water Act [33 U.S.C. 1344(m)].

In our June 17, 1994 letter to the New England Division, the Service identified a number of issues that needed additional study and evaluation prior to the adoption of the final selected plan. Some such as Rowes Quarry have been completed while others such as the collection of seasonal data to identify spatial and temporal uses of the aquatic sites, demonstration of the geotextile disposal technology, a full evaluation of the regulated navigation area alternative, and the development of a supplemental EIR/S are incomplete or were rejected. Additionally, some new questions have been raised as a consequence of the new information presented and/or alternatives selected as components of the final project.

During the scoping and evaluation process, the Service has consistently viewed the in-channel disposal option as a reasonable alternative for the disposal of contaminated material. Our reservations with in-channel disposal rest primarily with the additional impacts associated with dredging and disposal of material to create in-channel disposal pits, water quality effects during the projected 18-month construction period, and the degree to which the various fractions of the maintenance-type material can be dredged and contained within the disposal pits.

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AUG 15 1995
REGULATORY DIVISION

The water quality modeling that was conducted for the dredging and in-channel disposal option depicted total suspended solids (TSS) plumes based only on silt and clay (mineral) fractions. Organic particulate matter in its various forms was not evaluated to determined the spatial and temporal characteristics of these plumes during the dredging and disposal process. Additionally, no evaluation was conducted to determine the environmental consequences resulting when contaminants that are bound to the organic fraction become available for biological uptake while in the water column and/or at their new deposition site. The total organic carbon content of the surficial dredge material ranges from 1-9 percent with levels of 4-5 percent being commonplace. The organic fraction frequently contains a significant percentage of the total loading of toxic compounds in the dredge material. Because of the flocculent nature of this sediment fraction, we expect that it would comprise a significant portion of the sediment lost or disturbed during the dredging and disposal process. The fall velocity of organic particulate matter depicted as natural detritus on Table 2.2 of the Water Quality Modeling Report is several orders of magnitude lower than for clay or silt fractions used in the TSS modeling work. Consequently, because of this differential settling pattern, we are concerned that the organic particulate fraction with its attendant contaminant load would develop into a much larger, longer lasting plume than those depicted in figures 3.1-3.11 of the Water Quality Report. Conceivably, a large portion of the inner harbor could be affected during the 18-month construction period. Once the contaminants become suspended in the water column, they may be available for direct biological uptake or they may be redistributed to the surficial sediments at other locations in the harbor where they could become available for biological uptake. The Massachusetts Water Quality Standards (314 CMR 4.05) contain a requirement that surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife, or that interfere with the propagation of fish or shellfish or adversely affect benthic organisms. The final EIR/S does not provide an analysis of this important and complex water quality issue as herein described. The potential environmental consequences of this exposure pathway need to be evaluated.

The final EIR/S concludes that dredging and in-channel disposal would result in a clean substrate for aquatic life in the navigation channels affected by maintenance and/or improvement dredging. This conclusion by the Corps/Massport assumes that all of the contaminated sediments can be removed by the dredging process and subsequently, be contained in the in-channel disposal pits. The Service is concerned that some portion of the flocculent and/or high water content material residing in these channels will not be removed by dredging. Second, for that portion of these materials that is dredged and deposited in a barge and then subsequently dumped at an in-channel pit, we are concerned that those flocculent and/or high water content materials actually deposited in the pit will be displaced by heavier, more consolidated sediments, forcing the materials of concern back to the surface of the disposal pits and channel bottom. In effect, the so-called "mayonnaise layer" in the navigation channel would get disturbed, resuspended, and moved around during the dredging and disposal process but would still cover an undefined portion of the bottom of the navigation channel when the project is completed. Some evidence to support these concerns

can be inferred from the pilot project for disposal of PCB contaminated sediments in New Bedford Harbor. The sediments in New Bedford were dredged with hydraulic dredges and deposited in subaqueous disposal pits. When capping material was added to this high water content dredge material, mixing and displacement occurred, resulting in an ineffective containment and capping operation. In our view, the substrate conditions in the navigation channel are unlikely to be rendered free from contaminated sediments as a consequence of the dredging and disposal process, as the Corps/Massport contend. However, we do not believe that the contaminant conditions in the channel sediments will be made worse by dredging unless the deeper channel causes changes in stratification or other water column conditions.

In addition to selecting the in-channel option as the preferred disposal site alternative, the Little Mystic Channel was also selected as a contingency disposal site. Little Mystic Channel has a capacity of about 300,000 c.y., assuming 15 acres of subtidal habitat are filled to a variable intertidal elevation. While this proposal is less damaging to the aquatic system than filling to create fast land, the impacts may still be significant, given the cumulative effects of dredge and fill activities in Boston Harbor which has resulted in the loss of over 3,200 acres of intertidal and subtidal habitat and the degradation of several hundreds of acres of aquatic habitat by dredging. The limited biological studies conducted by Massport demonstrate that this subtidal habitat is utilized by finfish and lobster. The benthic community is typical of those found on intermittently stressed subtidal habitat as opportunistic, short-lived species apparently predominate. Water quality conditions are scheduled to be improved in the Little Mystic as a consequence of combined sewer overflow and other stormwater abatement measures during the next several years. Water quality and habitat suitability for aquatic life may change dramatically during or prior to the construction phase of the navigation improvement project.

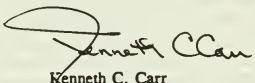
Because the Little Mystic Channel is proposed to be filled to an intertidal elevation, the concerns we expressed about the flocculent and high water content sediments being displaced and forced to the surface by heavier, more consolidated material become more critical. Since these sediment fractions can be expected to contain a significant contaminant load, they would likely be available for uptake by a variety of aquatic life and wildlife. In our view, the Little Mystic Channel proposal would contribute to the significant degradation already existing in Boston Harbor first, by filling an additional 15 acres of subtidal habitat and second, by having a reasonable likelihood of creating contaminated intertidal habitat. For these reasons, we recommend that the Little Mystic channel be deleted from your project plans as a contingency site.

The funding uncertainties for the Federal improvement and maintenance dredging accounts may provide a window of opportunity for the Corps/Massport to more fully evaluate the new issues raised in this letter and those in our previous letters. If funding is not appropriated for construction in the proposed and subsequent Water Resource Development Acts, existing resources may be well spent evaluating the regulated navigation area, relocation of terminals

to the existing 40-foot channel, the use of geotextile bags, and perhaps other innovative disposal technology to dispose of contaminated sediment as cost-effective alternatives to the proposed project or disposal alternatives.

In summary, we cannot concur at this time with your assessment that the in-channel location is the least damaging practicable alternative for the disposal of contaminated sediments in Boston Harbor. The outstanding water quality issues need to be evaluated and the environmental consequences understood before final decisions on the in-channel disposal alternative are made. Due to the significant degradation in Boston Harbor from cumulative dredge and fill activities, we do not concur that use of the Little Mystic Channel is an acceptable disposal alternative, or that such disposal complies with the 404(b)(1) Guidelines. We recommend that Little Mystic Channel be deleted as a contingency site. Questions concerning these comments should be directed to Mr. Vern Lang of this office at 603-225-1411.

Sincerely yours,



Kenneth C. Carr
Acting Supervisor
New England Field Office

CC: Reading File
P. Jackson, NED
P. Colarusso, EPA
P. Whitten, EPA
C. Mantzaris, NMFS
N. Faramelli, Massport
L. Bridges, MADMF
J. Perry, MADEP/DWPC
D. Bobb-Brott, MACZM
S. Lipman, MADEP
OEPC
BFA (ERT)

ES: VLang:jd:8-11-95:603-225-1411

Responses to Letter From
U.S. Department of the Interior, Fish and Wildlife Service, New England Field Office, 11 August 1995

1. Pg. 2, para 1 - (see responses to ISSUE 7, Attach. 2-B)

2. Pg. 2, para 2 - (see responses to ISSUE 8, Attach. 2-B)

3. Pg. 3, para 2 -
Little Mystic Channel would be filled to -3 feet MLW, thereby maintaining a subtidal habitat. Also, see responses to ISSUE 11, Attach. 2-B.

4. Pg. 3, para 3 - (see responses to ISSUE 11, Attach. 2-B)

5. Pg. 3, para 4 -
As stated in response to comments on the DEIR/S, regulating the navigation channels (as was done in Providence Harbor) is not feasible for Boston Harbor, and relocating terminals in Boston Harbor is not practicable and could cause as much or more environmental impacts both upland and water-based. New England Division will continue to evaluate and monitor developments at other Corps Districts regarding the use of geotextile bags. There are no plans to develop a demonstration project for the project at the present time. The geotextile bags are considered uneconomical for a project of this size. Demonstration of geotextile bags and other technologies may be considered for maintenance of the project.

6. Pg. 4, last para -
The first sentence contradicts the assessment by the U.S. Environmental Protection Agency (which is the only agency with authority to veto a Corps determination) which states that the in-channel disposal alternative is the least damaging practicable alternative (LEDPA) for the contaminated material. In addition the Division Engineer has determined that the selected disposal plan for contaminated silt from Boston Harbor (for Federal and permit material) complies with Clean Water Act 404 (b)(1) guidelines. Water quality modeling was performed using Federal water quality criteria to determine if the disposal site passes Federal water quality standards. Volume 3, Section F of the FEIR/S describes the water quality modeling results. The disposal site is also expected to meet State water quality standards, which are generally more qualitative. The Massachusetts water quality certification process requires that a mixing zone, which defines the boundary where chronic water quality criteria are not violated, be established and this zone not interfere with nor impact local natural resources. In Massachusetts, Water Quality Certification and Coastal Zone Consistency Determination is not initiated until the MEPA (EIR) process is complete.

Also, refer to comment number 4 above regarding Little Mystic Channel.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
JOHN F. KENNEDY FEDERAL BUILDING
BOSTON, MASSACHUSETTS 02203-0001

August 23, 1995

Earle Richardson
Colonel, Corps of Engineers
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254-9149

OFFICE OF THE
REGIONAL ADMINISTRATOR

Dear Colonel Richardson:

In accordance with our responsibilities under the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act, we have reviewed the Final Environmental Impact Statement (FEIS) for the proposed Boston Harbor Navigation Improvement Project (BHNIP).

This project proposes to remove and dispose of approximately 3.4 million cubic yards (mcy) of sediment and 132,000 cubic yards of rock from the Reserved, Mystic River, and Chelsea Creek Channels, portions of the Main Ship Channel, and associated berthing areas in Boston Harbor in order to increase the navigational efficiency of Boston Harbor for deep draft vessels. Of this material, 1.3 mcy (essentially the surface silt material) is contaminated with metals, PCBs, PAHs, and other chemicals and is considered to be unsuitable for unconfined open water disposal under the Marine Protection, Research and Sanctuaries Act (33 U.S.C. Sec. 1401 et seq.) (MPRSA).

In addition to the above volumes, the Corps estimates that another 4.4 mcy of material will need to be removed from the Main Channel over the next 50 years to maintain channel depths. It is assumed that this material will also be unsuitable for unconfined open water disposal under the MPRSA. With this total volume, the BHNIP remains one of the largest dredging projects in the history of New England.

As in the DEIS, the FEIS evaluates two sets of alternatives - dredging alternatives and disposal alternatives for the dredged material. Dredging alternatives include: maintenance dredging only; the full project (maintenance and improvement dredging); a reduced-scale project; a delayed project; and No Action (no maintenance or improvement dredging). Disposal alternatives include several land-based and aquatic-based options, alone and in combination with each other.

In the DEIS the Corps proposed to approve the full project alternative and identified five preferred options for contaminated dredged material disposal: the Massachusetts Bay Disposal Site (MBDS); the Boston Lightship (BLS); Meisburger 2; Meisburger 7; and Spectacle Island Confined Aquatic Disposal (CAD). In the FEIS the

Corps continues to propose the full project alternative, but has identified In-Channel disposal (ICD) with capping as the Least Environmentally Damaging Practicable Alternative (LEDPA) for contaminated dredged material disposal. Under this alternative trenches would be dug into portions of the Boston Inner Harbor dredge site, then filled with contaminated silts and covered with clean cap material to authorized project depths. Based on our review of the FEIS, EPA endorses both the full project alternative and the In-Channel with capping disposal option.

Let me begin by saying that I believe the three-year coordinated effort between public and private groups to identify a sound dredging and disposal plan for the Port of Boston has been a constructive and successful process. When this environmental review began, there was little agreement between concerned groups over how to manage the Port's dredging problems. About the only thing that could be agreed on was the need and desire to maintain the economic vitality of one of our nation's oldest seaports.

Further, as you know, EPA's 6-27-94 comments on the DEIS raised serious environmental concerns about the Corps' previously preferred disposal sites, the adequacy of the environmental analysis in the EIS, issues surrounding the use of capping in deep ocean waters as a management tool for contaminated dredged material disposal, and the need to examine innovative technologies for dredged material management.

With release of the FEIS, some of these concerns remain; in particular, the proposed project does little to address the long-term needs of the Region for contaminated dredged material management. More effort is necessary from both our agencies and the states to find environmentally sound and technically innovative solutions to dredging problems that will continue to face Boston and other ports around New England and the country.

In other important respects, however, we believe that changes made by the Corps to the proposed project (discussed below) have been responsive to several major concerns expressed in EPA's earlier comments and that, as a result, significant improvements to the project have been achieved. Based on these improvements, as stated above, EPA endorses the Corps preferred disposal option--In-Channel with capping. We continue to have concerns, however, about the use of sites identified in the EIS for future contingency and maintenance material disposal. These and other issues are discussed more fully below.

o With regard to In-Channel Disposal, based on the analysis provided, EPA agrees that this option clearly has environmental and logistical advantages that place it well above other options evaluated in the EIS and that it represents the LEDPA for disposal of contaminated dredged material. As stated in our previous comments, this option has the advantage of a small footprint, or

total area of impact, in an area that has already been disturbed by previous dredging operations. Furthermore, based on the information available, biological resources at this site are of a lower quality in terms of benthic productivity and diversity than those at the other sites examined. Impacts to these resources will be temporary, while biological quality in the longer term will improve with the use of clean cap material (or at least be no worse than what currently exists at this site). Finally, we believe that water quality and down-stream impacts from dredging and disposal in-channel, if properly managed, will be minimal.

o With regard to other sites considered for future use, the FEIS indicates that Little Mystic Channel (LMC) is the LEDPA for a "contingency site" (in case more capacity is needed for the BHNIP material), while the MBDS (with capping), BLS, the Meisberger sites, and some upland sites may be suitable for future maintenance material.

Our position with regard to use of the MBDS and BLS are discussed further below. With regard to the other sites identified, EPA supports the proposed excavation of in-channel cells to create extra capacity and, following this, the use of upland sites for excess material. Aquatic sites, such as LMC, should not be considered until all upland sites have been exhausted or ruled impracticable. Further, we continue to believe that more scientific information is necessary to fully evaluate the potential environmental impacts of disposal at the sites identified for future use in the FEIS, including LMC, and thus cannot endorse these sites at this time (see 6-27-94 comments).

o Concerning the previously proposed use of the MBDS with capping, we applaud the Corps' decision to drop this option as an alternative for contaminated dredged material disposal. As you are aware, EPA raised serious objections to this alternative in our comments on the DEIS based on concerns that remain today about the efficacy of capping (see 6-27-94 comments). Stated briefly, EPA believes that capping of contaminated dredged material has not been shown to be an effective, environmentally sound approach to disposal of contaminated sediments at deep water sites like the MBDS or the BLS. Based on this, we do not consider either MBDS or BLS to be legitimate disposal options for material that does not meet requirements under the MPRSA.

We reiterate, however, that our respective agencies bear a responsibility to resolve together the uncertainties of capping as a disposal technique and that a joint demonstration project using dredged material that meets the requirements of the MPRSA would be helpful to that end. We recommend a meeting in the near future to discuss our prospects for a collaborative effort in this regard.

o We commend the Corps for its re-evaluation of surface sediment quality from the BHNIP and its associated berthing areas. Based on

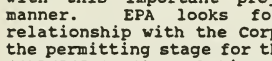
this re-evaluation, our agencies are in agreement that the 1.3 mcy of maintenance material to be dredged from this project does not meet the ocean discharge criteria under 40 CFR Part 227 and thus is not suitable for unconfined open water disposal as regulated under the Marine Protection, Research and Sanctuaries Act (33 U.S.C. Sec. 1401 et seq.) (MPRSA).

- We appreciate the additional information provided in the FEIS on combination disposal site alternatives and the potential secondary and cumulative impacts from the BHNIP. While the benefits of the ICD option clearly outweigh any of the combination alternatives considered, these options may show more promise in the future. In this respect, we believe that the FEIS improved on the previous analysis provided in the DEIS. With regard to practicability, however, we found the discussion of criteria by which an alternative was judged practicable to be confusing in that it seemed to arbitrarily apply standards, such as whether a site was publicly or privately owned or whether there is a need for additional data, when drawing its conclusions. We would want to reexamine this approach should it be taken again in the future.

- Finally, there are important issues about the implementation and operation of the future dredging activities for the BHNIP that have been legitimately deferred until the permitting process for this project. It is important to understand, however, that the environmental acceptability of the BHNIP project hinges in no small part on the application of appropriate permit conditions and their proper implementation. It will thus be very important that our agencies and other interested parties work closely together during the next phase of this project.

In conclusion we would like to thank the Corps and Massport for the opportunity to work closely with them and others over the past many months on the analysis and design of the BHNIP. It is in my judgement a testimony to the twin goals of sound environmental management and responsible development that so many disparate groups were together able to forge a consensus on how to proceed with this important project in an environmentally protective manner. EPA looks forward to a continued close working relationship with the Corps and others as our agencies move into the permitting stage for this project. Please feel free to call me (617/565-3400) or Patience Whitten of my staff (617/565-3413) if you have any questions or comments.

Sincerely,



John P. DeVillars
Regional Administrator

Responses to Letter From
U.S. Environmental Protection Agency, Region 1, 23 August 1995

1. Pg. 2, para 4 -

New England Division is committed to providing appropriate resources to address the long-term needs for the region for disposal of contaminated sediment. NED has conducted Section 22 studies to begin to identify the need and issues on this topic. We will continue to provide support, along with the Commonwealth of Massachusetts (and other states), U.S. EPA, and other appropriate agencies to address this question.

2. Pg. 3, para 2-3 -

Before any site would be used for future disposal of contaminated material, the NEPA process would be initiated, and applicable environmental laws and regulations followed. If other sites, besides Little Mystic Channel, are considered as the LEDPA site then they would be used.

3. Pg. 3, para 4 -

The New England Division will evaluate projects as they come along to demonstrate the feasibility of capping at the MBDS. These demonstration projects would be coordinated with appropriate agencies, including the U.S. EPA.

4. Pg. 4, para 2 -

We would continue to coordinate with appropriate agencies on criteria for alternatives in the future, if it is determined to be pertinent.

5. Pg. 4, para 3 -

The Corps and Massport are working closely with the State agencies to resolve any remaining concerns regarding permit conditions and project implementation. It is expected that these concerns will be resolved in a timely manner.

UNITED STATES DEPARTMENT OF COMMERCE
Office of the Under Secretary for
Oceans and Atmosphere
Washington, D.C. 20230

August 29, 1995

SEP 1 -

Colonel Earle C. Richardson
Division Engineer
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254-9149

Dear Colonel Richardson:

The National Oceanic and Atmospheric Administration (NOAA) has reviewed the Final Environmental Impact Report/Statement (FEIR/S) for the Boston Harbor Navigation Improvement and Berth Dredging Project. The enclosed comments incorporate concerns from the National Marine Fisheries Service, the Stellwagen Bank National Marine Sanctuary, and the National Ocean Service / Office of Coastal Resource Management.

The proposed project would include dredging 1,100,000 cubic yards (cy) of contaminated silt, 1,680,000 cy of uncontaminated parent material (primarily clay), and 88,000 cy of rock. An additional 1,800,000 cy of parent material would be dredged to create in-channel disposal sites for the contaminated material, and the disposal sites would be capped with a three foot layer of clean sand. Portions of the cap would then be armored with rock to protect against erosion. Because of expansion during dredging and handling, a larger volume of material would require disposal: 1,360,000 cy of silt, 132,000 cy of rock, and 3,331,000 cy of parent material. Another 6,125,000 cy of material from the main channel and tributaries (most of which presumably will be contaminated) would require disposal over the 50 year design life of the project.

NOAA provided extensive comments on the Draft EIR/S, and many of our concerns have been addressed in the FEIR/S. However, a number of important issues remain. We recommend that the Corps of Engineers address these concerns before proceeding with the federal navigation project, and prior to issuing a permit to Massport for the non-federal portions of the project.

If you have any questions about our comments, please contact Jonathan Kurland at (508) 281-9204.

Sincerely,

Donna Wieting
Acting Director
Ecology and Conservation Office

Enclosure

cc: Trudy Coxe - Massachusetts EOEA
Ed Woo - EPA
Vern Lang - USFWS
Deerin Babb-Brott - MA CZM
Scott Cassel - MA EOEA
Leigh Bridges - MA DMF
Cathy Demos - ACOE, Waltham
Pete Jackson - ACOE, Waltham
Karen Adams - ACOE, Waltham
Pat Fiorelli - NEFMC, Saugus
Janeen Hanson - Massport
Grace Perez - Conservation Law Foundation
Jodi Sugerman - Save the Harbor / Save the Bay
Tim Eichenberg - Center for Marine Conservation

NOAA:
F/NEO2 - Laurie Silva, Jon Kurland
F/NECx1 - David Dow
F/HP1 - Jim Burgess
N/ORM240 - Brad Barr
N/ORM3 - Patricia Scott

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)
COMMENTS ON THE FINAL ENVIRONMENTAL IMPACT STATEMENT/REPORT
FOR THE BOSTON HARBOR NAVIGATION IMPROVEMENT PROJECT

NOAA has a number of outstanding concerns regarding the proposed Boston Harbor Navigation Improvement Project. We recommend that the Corps of Engineers address the following issues (which are not necessarily listed in order of priority) before proceeding with the federal navigation project, and prior to issuing a permit to Massport for the non-federal portions of the project.

1. The finfish and benthic sampling performed by Normandeau Associates at the proposed in-channel disposal sites does not provide an adequate characterization of the habitat value of those sites or their seasonal use by important living marine resources. NOAA is concerned that sufficient data does not exist to determine the seasonal distribution of species such as winter flounder, menhaden, river herring, and rainbow smelt in the Inner Confluence, Chelsea Creek, and the Mystic River. It will not be possible to determine whether existing habitat functions are restored after dredged material disposal and capping unless the existing conditions are documented before the project begins. We recommend that the Corps and Massport continue their fish sampling effort for the in-channel sites, but increase the frequency of sampling to once per month for a minimum of 12 months. Based on the results of this sampling, additional coordination with the National Marine Fisheries Service and Massachusetts Division of Marine Fisheries may be necessary to refine the Dredging Management Plan to minimize conflicts between dredging and fish in Boston Harbor.

2. The FEIR/S does not provide a detailed analysis of the anticipated capacity of the in-channel disposal sites, and suggests that the in-channel sites might not provide the volume necessary to hold all of the contaminated dredged material. Based on previous presentations from the Corps, we were under the impression that the in-channel sites had more than adequate capacity. We recommend that the Corps re-examine this issue and include in the Dredging Management Plan specific procedures to ensure that disposal cells will be built sufficiently deep and filled to the maximum necessary capacity to hold all of the contaminated sediments. The Corps should also develop specific contingency plans for disposal of any contaminated material that cannot be contained in-channel. As discussed below, based on the information currently available, NOAA does not concur with the FEIR/S conclusion that disposal in Little Mystic Channel is the least environmentally damaging practicable alternative for dredged material that cannot be contained in-channel.

3. The FEIR/S selects Little Mystic Channel as an alternative disposal site for up to 373,000 cy of contaminated dredged material. The material would be capped on-site, changing approximately 15 acres of the existing bottom to an intertidal environment. Based on the limited fish data collected for this project, Little Mystic Channel, although somewhat degraded at present, provides valuable habitat for a variety of marine species including lobster, winter flounder, rainbow smelt, Atlantic tomcod, alewife, cunner, and butterfish. With the ongoing effort to improve water quality in Boston Harbor, habitat conditions in Little Mystic Channel will likely improve over time. We recommend that the Corps and Massport evaluate the practicability of less damaging alternative disposal sites for any dredged material that cannot be contained in-channel. For example, upland disposal may be feasible for a limited quantity of material, or additional in-channel cells could be created in Chelsea Creek below the Chelsea Street bridge.

4. The FEIR/S describes the capping procedure for the in-channel cells including the placement of a three foot sand cap over each cell and rock armoring over portions of the cap that are susceptible to erosion from vessel activity. We agree that a three foot sand cap is appropriate for this project, and that it should be armored as necessary. We recommend that the Corps identify the source of the sand as early as possible in project planning, particularly if offshore sand mining is being considered, since extensive coordination with NOAA and other agencies would be necessary. We also recommend that the Corps identify which portions of the cap would be armored, and coordinate that decision with the state and federal resource agencies.

5. In NOAA's comments on the Draft EIR/S, we expressed concern about the potential for residual contaminated silt to be mixed in with parent clay material during the dredging process and dumped at the Massachusetts Bay Disposal Site (MBDS). We also recommended that the FEIR/S evaluate the degree of such mixing in detail. The FEIR/S acknowledges that some silty material would be left behind in Boston Harbor after the initial dredging with environmental buckets is complete, but the document does not estimate what fraction of this material would then be dredged with standard toothed buckets along with the clean parent material and subsequently transported to MBDS. We continue to recommend that the Corps attempt to quantify what fraction of the dredged parent material (on a barge-load basis) would be tainted by residual contaminated silt, and assess the effects of dumping this material at MBDS.

6. The FEIR/S discusses in detail the various technologies that would be used to minimize the environmental impacts of dredging contaminated sediments. These techniques include using sealed environmental bucket dredges, integral bucket covers with purge

valves, seal indicators, and other sophisticated equipment. These measures should substantially reduce turbidity and the release of contaminants during the dredging operations. However, the FEIR/S does not discuss any comparable measures to be used during in-channel dredged material disposal. Instead, it appears that dredged material which would be carefully removed from the harbor to minimize the loss of contaminated silt would later be dumped from scows without containment into the in-channel disposal cells. Given the large quantity of silty material requiring disposal, we recommend that the Corps and Massport evaluate the feasibility of using available technologies for turbidity control during disposal operations. A variety of devices have been used for dredged material disposal projects, including "elephant trunks" -- large chutes through which the material can be shunted down to the bottom, limiting turbidity to the immediate vicinity of the disposal site. The chutes can also be fitted with deflectors to aid in dredged material placement. This technology and/or others could substantially reduce the indirect impacts of the disposal process.

7. The FEIR/S discusses the possible need to limit or stop the proposed project in the Mystic River and Inner Confluence during the migratory and spawning periods for winter flounder and anadromous fish from February 1 though June 15. The document also states that sonic startle systems, bubble curtains, or other devices would be used to encourage fish to leave the work area during blasting. Depending on the concentration and seasonal distribution of fish in the Mystic River, Chelsea Creek, and the Inner Confluence, it may be appropriate to use a fish startle system together with side scan sonar on a frequent basis throughout the entire project, not just during blasting. During project implementation, decisions about when to use such techniques and when it may be necessary to stop project operations temporarily to protect marine resources are best left to a qualified fisheries biologist working on-site. We recommend that the Corps and Massport retain an independent fisheries biologist (e.g., working for the Massachusetts Division of Marine Fisheries rather than the dredge contractor) to monitor the project full time, dividing his or her time between the two dredge plants working on the project.

8. Project plans call for disposing of the rock and parent dredged material from the project at the Massachusetts Bay Disposal Site (MBDS). NOAA is concerned with ensuring that appropriate procedures are in place to confirm the location of the scows immediately prior to disposal. Side scan sonar has detected evidence of rock disposal on Stellwagen Bank during the period prior to the final designation of MBDS. A portion of this rock material appears to have been dumped within the boundary of the Stellwagen Bank National Marine Sanctuary. Although the current (final) MBDS site is further from Stellwagen Bank, it remains important to confirm that scows are located at the

approved disposal site prior to the release of dredged material. If the Corps intends to use more than one disposal location within the approved MBDS boundary (e.g., if rock would be dumped in a different location than clay, or if clay disposal would be spread over more than one location), we recommend that the Corps deploy taut wire buoys at each intended dump site. We also recommend that the Corps require the contractor to use an independent disposal inspector (i.e., not employed by the dredge contractor) on each scow bound for MBDS, and that the inspector maintain a log of each disposal event to confirm that disposal occurs only at the appropriate MBDS disposal buoy.

9. We recommend that the Corps and Massport develop a specific long-term monitoring program for the in-channel disposal sites to document cap integrity over time and re-colonization by benthic organisms, fish, shellfish, and crustaceans. The discussion on long-term monitoring in the FEIR/S is far too general, since it relies on the Corps' existing DAMOS monitoring program to evaluate the disposal sites for this project. The DAMOS program has limited resources, and may not be capable of carrying out a full monitoring program for this project. Instead, we recommend using a separately funded monitoring program specifically tailored to this project, and developed in consultation with NOAA and the other federal and state resource agencies. The monitoring should focus on both the initial placement of a cap over the in-channel disposal cells and the long term stability of the cap, particularly since in-channel dredged material disposal is a relatively new technique. Since the project includes numerous private berth owners, we recommend that you condition the permit for the non-federal portion of the project to require the applicants to fund an appropriate share of the monitoring.

10. NOAA recently received from the Corps a revised Biological Assessment for this project pursuant to Section 7(c) of the Endangered Species Act. The National Marine Fisheries Service is currently reviewing that document and will prepare a Biological Opinion, which will be forwarded to you under separate cover.

11. Pursuant to Sections 304(d) and 2202 of the National Marine Sanctuaries Act, the Corps has indicated that it will soon initiate formal consultation with the Stellwagen Bank National Marine Sanctuary since this project may affect Sanctuary resources. The Corps will be required to submit to the Sanctuary a written statement describing the project and its potential effects on Sanctuary resources. While NOAA would encourage the Corps to initiate consultation as soon as possible, this statement must be provided to the Sanctuary no later than 45 days before the final approval of the project. To expedite this process, NOAA suggests that the Corps meet at the earliest possible time with the Sanctuary Manager to discuss the consultation for this project.

12. Various sections of the FEIR/S refer to Massachusetts Coastal Zone Management consistency requirements, but the document does not appear to include the Corps' federal consistency certification for the proposed action as required by Section 307 of the Coastal Zone Management Act (CZMA). In accordance with the 1990 amendments to the CZMA (16 U.S.C. Section 1451 et seq), federal agency activities within or outside the coastal zone that affect any land or water use or natural resource of the coastal zone are required to be conducted in a manner that is consistent to the maximum extent practicable with the enforceable policies of the Massachusetts Coastal Zone Management Program (see Section 307(c)(1)(A) of the CZMA).

13. The FEIR/S does not specifically discuss the socioeconomic environment that would be affected by the proposed project (including population, employment, etc.) or the anticipated impacts to these human uses. Also, if appropriate, the Corps should make an effort to comply with the Executive Order (dated February 11, 1994) on Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. That order is designed to focus federal attention on the environmental and human health conditions in minority communities and low-income communities with the goal of achieving environmental justice.

Responses to Letter From
U.S. Department of Commerce, Office of the Under Secretary for Oceans and Atmosphere, 29 August 1995

1. Pg. 1, para 1- (see responses to ISSUE 1, Attach. 2-B)

2. Pg.1, para 2 - (see responses to ISSUE 2, Attach. 2-B)

3. Pg. 2, para 3 - (see responses to ISSUE 11, Attach. 2-B)

4. Pg. 2, para 4 -

The sand is likely to come from a commercial upland source. If the sand were to be mined from an offshore location, then appropriate coordination would take place. Initial evaluations indicate that armoring will occur in Inner Confluence and in cells 13-18 in the Mystic River. We will meet with the State agencies to address these topics.

5. Pg. 2, para 5 - (see responses to ISSUE 3, Attach. 2-B)

6. Pg. 3, para 6 - (see responses to ISSUE 4, Attach. 2-B)

7. Pg. 3, para 7 - (see responses to ISSUE 5, Attach. 2-B)

8. Pg. 3, para 8 -

The Corps employs inspectors for recording disposal location and time and taut-wire buoys for targeting the disposal point. No short or long disposal is expected. The material to be disposed at the MBDS is clean Boston blue clay, sand or gravel. In addition an independent observer will be hired to monitor dredging and disposal activities for Mass. CZM.

9. Pg. 4, para 9 - (see responses to ISSUE 10, Attach. 2-B)

10. Pg.4, para 11 - (see responses to ISSUE 6, Attach. 2-B)

11. Pg. 5, para 12 -

As stated in the FEIR/S, the Corps will be applying for a Coastal Zone consistency determination from the Commonwealth of Massachusetts. The Corps can not apply for a consistency determination until the MEPA process is complete.

12. Pg. 5, para 13 -

Socioeconomic factors were discussed in the DEIR/S. Because the project will stay within the current project limits, no additional adverse impacts to low income or minority populations is expected. In fact, capping the contaminated material with clean material can improve the environment.

The Comm
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WILLIAM F. WELD
GOVERNOR
ARGEO PAUL CELLUCCI
LIEUTENANT GOVERNOR
TRUDY COXE
SECRETARY

Post-it™ brand fax transmittal memo 7671 | # of pages ▸ 6
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CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS
ON THE
FINAL ENVIRONMENTAL IMPACT REPORT

PROJECT NAME	: Boston Harbor Navigation Improvement and Berth Dredging Project
PROJECT LOCATION	: Boston
EOEA NUMBER	: 8695
PROJECT PROPONENT	: Massport
DATE NOTICED IN MONITOR	: August 8, 1995

The Secretary of Environmental Affairs herein issues a statement that the Final Environmental Impact Report submitted on the above project adequately and properly complies with the Massachusetts Environmental Policy Act (G. L. c. 30, s. 61-62H) and with its implementing regulations (301 CMR 11.00).

The Boston Harbor Navigation Improvement Project (BHNIP) involves improvement dredging of approximately 3,300,000 cubic yards (cy) of sediments and bedrock from three channels in the Mystic River, Chelsea Creek and the Reserved Channel, and from twelve or more berth areas. The Mystic River and Reserved Channel will be dredged to -40 feet mean low water datum (ft mlw), Chelsea Creek to -38 ft mlw, and the berth areas to the depth of the channel on which they are located.

The materials to be dredged include approximately 132,000 cy of bedrock to be blasted from the main ship channel, 2,000,000 cy of Boston blue clay and approximately 1,300,000 cy of contaminated silts. The bedrock and Boston blue clay are uncontaminated and are suitable for unconfined disposal at the Massachusetts Bay Disposal Site (MBDS). The contaminated silts are not suitable for unconfined ocean disposal.

The Final EIR has evaluated a number of alternative disposal schemes for the contaminated sediments and has identified in-channel disposal in borrow pits, with capping by clean sediments, as the least environmentally damaging disposal option. The uncontaminated sediments and bedrock will be disposed at the MBDS.

Based on the comments received on the FEIR, this option has broad support among Federal and State regulatory agencies and environmental groups. The FEIR has shown that this proposal is feasible and that it should result in significant environmental as well as navigational benefits.

Although the FEIR has adequately defined the project and has shown it to be feasible, there are several areas where additional details and controls will be required before permits can be issued. I expect that the permitting agencies will provide the necessary detail and controls in Section 61 Findings issued prior to or contemporaneously with any permits. The following issues will require detailed analysis in Section 61 Findings.

WATER QUALITY MONITORING

Although the FEIR and supplemental water quality modelling information provided during review of the FEIR has indicated that the proposed project can be implemented so as to meet State and Federal Water Quality Standards, the Section 61 Finding issued with the Section 401 Water Quality Certification should provide for additional water quality monitoring to ensure protection of fishery resources. This Section 61 Finding should also provide a contingency plan to utilize side scan sonar and/or a fish "startle" system to protect fisheries resources in the event of an unanticipated water quality problem.

FISHERIES SAMPLING

The FEIR provides data from a spring and fall fisheries sampling program. The Division of Marine Fisheries indicates that a monthly sampling of fisheries resources is crucial to an understanding of fish activity within the dredging and disposal areas. In the absence of this monthly sampling data, the Division indicates that permanent fish protection devices will be required during the dredging and disposal operations. I expect that this issue will be addressed in the 401 review process and will be included in the Section 61 Finding issued under Water Quality Certification.

CAPACITY OF IN-CHANNEL DISPOSAL

The Corps of Engineers has indicated confidence that the proposed in-channel disposal pits will have adequate capacity for the contaminated silts. The Corps also indicates that further capacity can be created in-channel without causing adverse environmental impact. For purposes of this decision, I accept the Corps assertions. However, if these assertions prove to be incorrect during construction and additional capacity in other than in-channel locations is required, Massport should file a Notice of Project Change as soon as the shortfall is identified to ensure proper environmental review of an alternative disposal site.

PROTECTION OF UTILITIES

The comments of the Massachusetts Water Resources Authority and the Boston Water and Sewer Commission identify a number of utilities that are located within the dredging and disposal areas. Massport should coordinate closely with these agencies prior to and during the dredging operation.

DREDGE MANAGEMENT PLAN AND MONITORING OF RESULTS

The FEIR contains a dredge management plan that provides a generalized overview of the technical details of the dredging and disposal elements. Timing, methodology, and sequencing of operations are expected to be specifically determined during permitting. I expect that Massport will provide the Department of Environmental Protection with sufficient information in the permit applications to allow the Section 61 Finding to contain a detailed management plan, including contingency plans. These contingency plans should be responsive to the specific comments contained in the attached letters.

Furthermore, the FEIR is unable to provide detailed information on cell construction, performance during disposal, and capping success. This information can only be gained during the dredging and disposal operations. The Section 61 Finding should provide a detailed monitoring plan to ensure that this disposal option can meet the environmental performance standards. I note that, once a clear understanding of cell performance is obtained, further monitoring should only be required to confirm that standards are being met.

BENEFICIAL REUSE

The DEP indicates in its comment letter that much of the parent (uncontaminated) material to be dredged could be used as capping material on landfills that are currently being, or will shortly be, closed. Although I recognize that this disposal option may not be currently cost-effective for this project, I believe that this option should be included in the project design and listed as an option in the bid documents to ensure that this beneficial reuse occurs if practicable.

INDEPENDENT MONITORING

Although I cannot specifically require independent environmental monitoring of the dredging and disposal operations, I agree with many of the commentors that such a monitor, reporting directly to the State regulatory agencies, is likely to further ensure strict compliance with environmental standards and I urge Massport to give this proposal further consideration.

PROJECT CHANGES

The finding of adequacy on this FEIR is based in part on the quality of its analysis, but also on a major assumption that the preferred alternative will be successful as proposed and that other alternatives, such as Upland Disposal and the Little Mystic Channel, need not be further evaluated at this time.

Should information become available that the preferred alternative requires major modification, or that other alternatives will be needed, it is essential that a Notice of Project Change be filed forthwith. Given that other alternatives have in fact been identified and could be analyzed further now, it will not be possible to argue in the future that such further analysis and review should not be required for lack of time.

I encourage Massport to consider the suggestion by commentors that it participate in a demonstration project to identify another disposal site and methodology to provide the additional analysis that would be required for such a contingency and for long term maintenance dredging requirements.

LONG TERM MAINTENANCE DREDGING

Several commentors have expressed serious concerns with the long term maintenance dredging that will be required over the next fifty years to maintain the improved channels. Although this maintenance dredging is not necessarily a part of this project, it clearly will be required in the future and should be addressed by Massport and the Corps of Engineers sooner rather than later.

In this regard, I believe it is important that these agencies begin a project to find a safe, environmentally sound treatment or disposal process to deal with contaminated spoil from future maintenance dredging. The Corps has begun such a process with the Massachusetts Navigation and Dredging Study, and the EIR process has provided additional information on disposal sites. Furthermore, the Executive Office of Environmental Affairs, with funding from the Seaport Bond, is undertaking a statewide contaminated sediment disposal plan. MCZM has initiated implementation of this planning effort. I encourage Massport, MCZM and the Corps to continue these investigations and demonstrations.

COMMENTS

The attached comments provide further elaboration on these issues and identify some additional issues that warrant inclusion in Section 61 findings to be issued for this project. I expect that these comments will be carefully considered during review and permitting.

CONCLUSION

I find that the FEIR, supplemented by additional testing information, adequately addresses the majority of concerns with this project. With exception of those contingency issues which would require a Notice of Project Change, all the remaining issues can and should be addressed during agency permitting processes, many of which provide for additional public review and comment.

I wish to highlight the innovative process developed by the proponent and the reviewing agencies to define issues, including permitting issues, establish protocols and develop a comprehensive analysis that is likely to have long term benefits well beyond the short term implementation of the dredging

project.

I encourage Massport to continue cooperating with the Dredging Working Group to address the outstanding issues found in this Certificate and in the comments received on the FEIR.

September 14, 1995
Date

Trudy Coxe, Secretary

Comments received : Department of Environmental Protection
Coastal Zone Management
Division of Marine Fisheries
Massachusetts Water Resources Authority
Boston Environment Department
Boston Redevelopment Authority
Boston Water and Sewer Commission
Save the Harbor/Save the Bay
Coastal Advocacy Network
The Boston Harbor Association
Boston Towing and Transportation Company
InnovaTech Associates

TC/rf

Responses to Letter From
Executive Office of Environmental Affairs, (Certificate of the Secretary of Environmental Affairs), 14 September 1995

1. Pg. 2, para 4 -
It is anticipated that a plume monitoring program will be in place during construction of the project. Additional discussions with the Commonwealth, Massport and the Corps to discuss this contingency are planned.

2. Pg. 2, para 5 - (see responses to ISSUE 1, Attach. 2-B)

3. Pg. 3, para 1 -
Massport would take responsibility for filing a notice of project change if necessary.

4. Pg. 3, para 2 -
The Corps and Massport had several meetings with the Massachusetts Water Resources Authority staff to discuss utility relocation in 1994 and on November 2, 1995. Additional meetings are anticipated.

5. Pg. 3, para 3-4 -
Massport and the Corps will address concerns expressed by the Commonwealth on the dredging management plan. A plan to monitor the performance of the disposal cells will be coordinated with appropriate agencies. Also see responses to ISSUE 10, Attach. 2-B.

6. Pg. 4, para 1 -
The Corps can incorporate this option in the bid documents.

7. Pg. 4, para 2 - (see responses to ISSUE 9, Attach. 2-B)

8. Pg. 4, para 4 -
Massport will provide the essential information to the Commonwealth if this option becomes necessary.

9. Pg. 4, para 5 -
Massport, the Corps, and the U.S. EPA are supportive of a long-term maintenance dredging solution. These agencies will commit the appropriate resources, along with the Commonwealth, to address this concern.

10. Pg. 5, para 1-2 -
The EIR/S describes disposal options that may be suitable for future maintenance of the project. Prior to selecting a site for maintenance of this project the appropriate environmental procedures will be followed. As described in the previous response, Federal and state agencies have been working toward developing a long-term dredged material disposal plan for Massachusetts. If a plan is in place in time for required maintenance then its recommendation will be considered.

Attachment 2

Boston Harbor Navigation Improvement Project

Coordination with Federal and State Agencies Following the FEIR/S Comment Period

A. Letters from State Agencies on obtaining Water Quality Cert. and CZM Consistency

B. Permit Issues, Corps Responses, and letters from Federal and State Agencies

C. Biological Opinion

D. Stellwagen Bank Marine Sanctuary Consultation Letter

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Protection

William F. Weld
Governor
Argeo Paul Cellucci
Lt. Governor

Trudy Coxe
Secretary
David B. Struhs
Commissioner

December 28, 1995

Joseph Ignazio, Director of Planning
U.S. CORPS OF ENGINEERS
424 Trapelo Rd.
Waltham, MA 02254

Re: Boston Harbor Navigation Improvement Project

Dear Mr. Ignazio:

The proposed deepening of the navigation channels in Boston Harbor is a project that has received extensive review and coordination as it has been developed. While we don't have an actual application yet for 401 Water Quality Certification and do not know all the important operational details of the dredging and disposal within the Harbor, we do understand and concur in general with the proposed work as explained in the FEIR/EIS.

We fully expect to issue a conditional Water Quality Certification for the project in compliance with applicable state statutes and regulations.

If you have questions about this matter, please contact William Krol at 617-556-1099.

Sincerely,

Robert W. Golledge
Acting Director
Division of Wetlands and Waterways

cc: Steven Lipman, DEP/Boston Harbor Coordinator
John Simpson, DEP/Waterways Regulation Program
Peg Brady, Director, CZM
Cathy Demos, Planning Directorate, USCOE, Waltham
Bill Krol, DEP/DWW
bhnidp.ltr

COASTAL ZONE
MANAGEMENT

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

December 28, 1995

Mr. Joseph Ignazio, Director of Planning
USACE/NED
424 Trapelo Road
Waltham, MA 02254-9149

RE: Boston Harbor Navigation Improvement Project

Dear Mr. Ignazio:

The Massachusetts Coastal Zone Management (MCZM) Office has reviewed materials related to the above-referenced project. The information has been provided to MCZM solely for the purpose of an evaluation of the project's suitability for funding relative to MCZM's enforceable program policies. MCZM has not reviewed the information provided to make a federal consistency decision.

Based solely on the information provided, MCZM has not identified any inconsistencies with its enforceable program policies.

MCZM will make a federal consistency decision following receipt of a federal consistency determination, together with other required information for the above-referenced project.

Please let us know if there is any other information you require.

Sincerely,

Peg Brady
Director

MMB/dbb

cc: Robert Gollege, Acting Director
DEP/Division of Wetlands and Waterways
Steven Lipman, Boston Harbor Coordinator
DEP Commissioner's Office
Peter Jackson, Project Manager
USACE
Janeen Hansen, Project Manager
Massport

B. Permit Issues, Corps Responses, and Letters from Federal and State Agencies

Eleven issues have been identified from the agency comments included in Attachment 1 which require resolution during the permit process. These issues, summarized below (references in italics), have been discussed with the commenting agencies to assure that the Corps' responses, included in this attachment, are satisfactory and that there is a reasonable likelihood that all of the concerns will be resolved in a manner acceptable the Corps and the agencies during the permit process. Letters of concurrence from the agencies are also included in this attachment.

ISSUE 1: The need for additional finfish and benthic sampling.
Agencies requested additional finfish and benthic sampling beyond that performed in order to obtain further characterization and seasonal use.
NOAA : Pg. 1, para 1; EOEA: Pg. 2, para 5

ISSUE 2: Capacity of in-channel placement sites.
NOAA was concerned about disposal capacity and the proposed contingency site, Little Mystic Channel, which is not considered by NOAA to be acceptable without further study.
NOAA : Pg. 1, para 2

ISSUE 3: Contamination of clean (parent) material by residual contaminated silts.
NOAA was concerned that some unsuitable material will mix with the suitable material to be dumped at the Mass. Bay Disposal Site (MBDS).
NOAA : Pg. 2, para 5

ISSUE 4: Use of impact reduction technologies
NOAA was concerned that environmental controls for the disposal operations were not at the same technological level as those proposed for dredging operations.
NOAA : Pg. 3, para 6

ISSUE 5: expanded use of fish startle systems and dredging windows
NOAA was concerned about protection of fisheries during all phases of the project, not just blasting and recommended measures to be taken.
NOAA : Pg. 3, para 7

ISSUE 6: impacts to the Stellwagen Bank National Marine Sanctuary
NOAA requested consultation with the sanctuary as required in Sections 304(d) and 2202 of the National Marine Sanctuaries Act.
NOAA : Pg. 4, para 11

ISSUE 7: impacts caused by resuspension (plumes) of contaminants/sediments during the 18-month construction period
USFWS was concerned that the organic particulate faction of the dredged material was not adequately modeled therefore its impacts were not adequately addressed.
USFWS: Pg. 2, para 1

ISSUE 8: the degree to which various fractions of maintenance-type material can be dredged and successfully contained
Agencies were concerned that the EIS claim that the project will result in a clean substrate and that all disposed silts will be contained is unlikely.
USFWS: Pg. 2, para 2; EOEA: Pg. 3. para 4

ISSUE 9: Use of an independent observer
EOEA as well as other commentors have requested an independent observer to oversee the project operations and compliance with permit conditions.
EOEA: Pg. 4, para 2

ISSUE 10: implementation of a specific long-term monitoring program
NOAA indicated that a long-term monitoring program is necessary and that traditional programs may not be adequate funded for the required program.
NOAA : Pg. 4, para 9 ; EOEA: Pg. 3

ISSUE 11: use of Little Mystic Channel as a contingency site
NOAA and other commentors disagreed with the selection of Little Mystic Channel as a contingency disposal site if in-channel disposal capacity is inadequate.
NOAA: Pg. 2, para 3; USFWS: Pg. 3, paras 2 and 3

References to letters:
Federal Agencies:
USFWS - U.S. Department of the Interior, Fish and Wildlife Service, New England Field Office, 11 August 1995

EPA - U.S. Environmental Protection Agency, Region 1, 23 August 1995

NOAA - U.S. Department of Commerce, Office of the Under Secretary for Oceans and Atmosphere, 29 August 1995

Commonwealth of Massachusetts
EOEA - Executive Office of Environmental Affairs, (Certificate of the Secretary of Environmental Affairs), 14 September 1995

ISSUE 1: The need for additional finfish and benthic sampling.

NOAA : Pg. 1, para 1; EOEA: Pg. 2, para 5
The Corps and Massport have performed spring and fall benthic, lobster, and finfish sampling at the proposed disposal sites. This information, along with other research performed in the area, show the biological character of Boston Harbor. The Corps does not consider additional sampling necessary to biologically characterize the in-channel disposal site. Recent coordination with NMFS finds that after further consideration there is no need for additional finfish and benthic sampling if there is water quality monitoring and a fish monitor/observer during construction, and benthic studies conducted after construction.

ISSUE 2: Capacity of in-channel placement sites.

NOAA : Pg. 1, para 2
It is estimated that the volume of silt required to be disposed of in the in-channel cells is 1,134,000 CY (Table 2-2 FEIR/S). For disposal capacity estimates it was assumed that silt will expand by 20% from its in-situ volume during dredging and handling and will therefore require 1,361,000 CY of storage capacity in the cells. The 20% expansion factor is conservatively high for unconsolidated silt which is frequently agitated by tides and vessel movements. Also, please refer to contingency site considerations in Issue 11.

If the cells are excavated to the depths shown in Table 3-18 in the FEIR/S and all cells were utilized then 1,412,800 CY of silt storage capacity would be created. This provides about 50,000 CY of excess capacity. In addition, there is one cell in the Inner

Confluence that has not been included in previous capacity calculations which if excavated to -60 MLW could provide about 21,500 CY of silt capacity. Based on these assumptions it is estimated that 71,500 CY in excess silt disposal capacity is available.

There is potential for greater disposal capacity if subsurface conditions allow for deeper cells. Due to limits in the seismic reflection survey to read below certain depths it is not known if subsurface conditions will allow for deeper cells than shown in the FEIR/S. The construction specifications will be written to allow the contractor to excavate cells as deep as practicable to maximize cell capacity. For example, if the contractor is able to dredge just two feet deeper in three cells he would gain an extra 10,000 CY of capacity. Furthermore, more capacity may be realized if the cell side slopes can sustain a steeper slope than the one vertical to three horizontal (1 on 3) used in the FEIR/S estimates. Experience with dredging parent material at Massport's Moran Terminal in 1993 showed steep slopes were obtainable. Since there are a total of 54 cells to be dredged it would be reasonable to anticipate some additional capacity to become available during dredging either by dredging deeper or cutting steeper slopes.

Recent CAD-based calculations of silt in berth areas, based on subsurface borings and surveys, indicate that volumes used in the FEIR/S are conservatively high.

ISSUE 3: Contamination of clean (parent) material by residual contaminated silts.

NOAA : Pg. 2, para 5
It is anticipated that some small amount of silt may be dredged during removal of the clean parent material, particularly along the boundaries of the work areas where some sloughing may occur. Because some "overdredging" into the parent layer will occur during the silt dredging it is unlikely that any silt will remain on the most of the work areas. This approach was used for the Central Artery/Third Harbor Tunnel Project for disposal of parent material at the MBDS.

It would be difficult to accurately determine the amount of silt on each barge. Although there are no known studies or monitoring that has looked at this issue, a reasonable estimate is that the contaminated silt would comprise less than 1% of the barge total. Most of the silt is light and would be displaced by the clamshell bucket during dredging. Even if the amount of contaminated material in the barge compromises a percentage larger than 1%, it is expected that the barge load would be suitable for unconfined disposal at the Massachusetts Bay Disposal Site (MBDS).

ISSUE 4: Use of impact reduction technologies

NOAA : Pg. 3, para 6
Water quality modeling results shows that dredging and disposal can be accomplished without violating water quality criteria. The Water Quality Modeling Report contained in Appendix F of the FEIR/S (Volume 3) demonstrated the lack of concentrations of constituents exceeding water quality criteria. Mixing zones based on TSS and PCB loadings were less than the width of the channel. These results indicate that additional precautions are not necessary.

There is a significant difference in the exposure of contaminated silts to the water column during dredging and disposal which helps to justify the use of an environmental bucket but no additional devices for disposal. It is noted that during the approximately 10 hours to load a scow the environmental bucket will move through the full water depth about 200 times. Conversely, the disposal process may take as little as two minutes to dump the entire 3-4,000 CY bargeload in one large cohesive mass. Also, the loaded barge would draw about 12-15 feet. When the doors open, another 5-8 feet of water column is partially shielded from contacting the silt during descent. Therefore only about 17 to 23 feet of the water column would be fully exposed to the silt over a short period of time.

Monitoring will be conducted to verify model results. If water quality certification is violated then contingency measures such as silt curtains or operational changes will be implemented.

ISSUE 5: expanded use of fish startle systems and dredging windows

NOAA : Pg. 3, para 7
The Corps and Massport are considering appropriate systems to minimize impacts to finfish during blasting. These measures which include stemming (blocking the charge hole with angular rock), and staggered (delayed sequence) charges in conjunction with pre-blast observations could reduce shock wave impacts by about 94% (Cape Fear, NC navigation improvement project). Additional measures such as bubble curtains or other barriers which could reduce impacts up 99.8% will also be evaluated. Traditional fish startle methods appear to have limited effectiveness and will not be used as the sole measure. Use of a fish monitor/observer could further reduce impacts to finfish during blasting by delaying blasting if large quantities of fish are observed in the area.

There are currently no plans to use devices to protect fish during dredging. Impacts to non-anadromous fish is expected to be minimal based on the water quality report and data from previously published reports. The fish will be able to travel around and avoid the dredging and disposal activity because the mixing zone extended only approximately 1/6 the distance across the respective channel width in the worst case disposal scenario (i.e. Mystic River). An environmental window (dredging and

disposal will cease in the Mystic Channel during February 1 to June 15) is part of the project to provide additional protection to anadromous finfish. As discussed in Issue 1 a fish monitor/observer would be included in the project. Massport and the Corps are preparing a scope of work for an independent observer (IO). The scope may include monitoring fish activity during project construction.

ISSUE 6: impacts to the Stellwagen Bank National Marine Sanctuary

NOAA : Pg. 4, para 11
The Corps has coordinated with the manager of the Stellwagen Bank National Marine Sanctuary (SBNMS) during the preparation of the EIR/S. A letter from the manager of the SBNMS states that the project has met the coordination requirements of the National Marine Sanctuaries Act.

ISSUE 7: impacts caused by resuspension (plumes) of contaminants/sediments during the 18-month construction period

USFWS: Pg. 2, para 1
Based on concerns expressed by agencies and environmental groups about potential water quality impacts from dredging and disposal, water quality modelling was performed to determine if the proposed project would violate applicable water quality standards. The results of the model indicated that water quality violations would not occur. Existing technology does not provide a method to accurately model organic particulate matter. It is recognized that this material has a longer settling time than the particles used in the water quality model. Contaminants would be expected to bind to the organic as well as inorganic fraction of the material. Although the water quality model does not analyze the organic portion of the material separately it is recognized that its concentration would be elevated during dredging and disposal and should quickly return to background levels after disposal activity ceases. This material is currently available to biological organisms in the harbor. Also, since the organic material is easily suspended by tidal currents and vessel traffic it is widely distributed throughout the harbor floor. It is likely that the project operations would show a measurable increase of organic particulate suspension, however it is not anticipated that the suspended particulates would significantly impact biological resources in the harbor. While there will be a temporary increase in turbidity in the harbor, the project will isolate some of the contaminated material upon completion of construction. Monitoring will measure total suspended solids, including organic particulates, to indicate any violations in water quality parameters.

The Corps and Massport will work with EOEA, USFWS and other interested agencies to develop a mutually agreeable water quality monitoring plan during the 401 certification/CZM consistency process.

ISSUE 8: the degree to which various fractions of maintenance-type material can be dredged and successfully contained

USFWS: Pg. 2, para 2; EOEA: Pg. 3. para 4
No where in the DEIR/S or the FEIR/S is it stated that all of the contaminated silt will be disposed in-channel. Only silt from that portion of the harbor which will be deepened will be disposed in-channel. However, this is a significant portion of the inner harbor. Even if the project did remove all of the flocculent material in the area dredged, similar material from adjacent areas will quickly move in and coat the deepened areas. The only method to prevent the covering of the dredged area with flocculent is to remove all flocculent from the harbor and stop all sources of this material which is beyond the scope of this project.

The New Bedford pilot study is not directly comparable to the BHNIP. The New Bedford Harbor project used a hydraulic dredge which entrains more water than mechanical dredging creating a more fluid material which had not settled adequately prior to capping attempts.

It is expected that some of the flocculent material will be displaced by heavier materials disposed in the cell. Work performed in Hong Kong Harbor showed evidence of a "mud lake" forming at the perimeter of a disposal cell. It appeared that disposal of dredged material into the cell was concentrated. The formation of a similar layer of flocculent material would be reduced by random disposal into the cell. Additionally, there is evidence that capping performed at the Eagle Harbor superfund site in Puget Sound was successful in containing soft sediments by using fire hoses to disperse sand from a deck barge to form the cap. The use of a sand slurry delivered at the water surface allowed "particles to fall to the bottom at their individual settling rates" and thus "minimized displacement of existing contaminated bottom sediments". The sand slurry method is proposed for the Boston Harbor Dredging Project.

In addition to a sand cap, portions of the in-channel disposal site that may be susceptible to erosion from vessel prop wash will be armored with project rock.

Boston Harbor is a tidal influenced estuary. The minor amount of deepening is not expected to significantly change the flushing rate currently experienced in the harbor for the following reasons. The inner harbor of Boston Harbor is very narrow, therefore, a normal mean tide range of 9.5 feet will interchange nearly 25% of the water in this area (9.5 feet tide range divided by 40 feet of average depth). With an approximate 5 feet increase in depth, the portion of the water interchanged will be reduced only a few percent to approximately 21% of the volume of water in the main channel. This large interchange in both pre- and post-dredged conditions should be sufficient to reduce most water quality problems associated with stratified conditions. The minor reduction in volume interchange would be made up within the next tide cycle. Therefore it is not expected that stratification or other water

column conditions will be worsened. By deepening the tributary channel to a depth close to or equal to that of the main ship channel (-40 feet MLW) circulation between the outer harbor and inner harbor and within the inner harbor may be improved at least near the channel bottom. Also, improved water quality conditions resulting from the MWRA project should further reduce the potential for low dissolved oxygen levels. A New England Aquarium 1990 report indicated that there was only a slight difference in dissolved oxygen levels between surface and bottom samples which points out that vertical mixing in Boston Harbor is considerable. In general violations in the inner harbor occurred in areas near CSO's such as the semi-enclosed Fort Point Channel (MWRA, 1993). Because there are no CSO's within the immediate vicinity of the dredging areas, and because the flushing rates and the considerable vertical mixing are high, the project should not significantly change dissolved oxygen levels in the harbor.

ISSUE 9: Use of an independent observer

EOEA: Pg. 4, para 2
The Corps and Massport are currently working with EOEA agencies on a scope of work for an independent observer.

ISSUE 10: implementation of a specific long-term monitoring program

NOAA : Pg. 4, para 9 ; EOEA: Pg. 3
It is anticipated that up to a year of monitoring will occur after completion of construction, as a project cost. The DAMOS program would provide some long-term monitoring of the in-channel disposal site. In addition, routine surveys will be conduced in areas requiring future maintenance for the BHNIP. These surveys when conducted in the area of cells will provide some cap data. Anticipated monitoring parameters could include cap integrity and benthic recolonization studies. The monitoring program will follow permit requirements.

ISSUE 11: use of Little Mystic Channel as a contingency site

NOAA: Pg. 2, para 3; USFWS: Pg. 3, paras 2 and 3
There are two other potential contingency options that would be implemented before the use of the Little Mystic Channel. These options include creating more in-channel cells outside the project limits and landfill. It may be possible to construct additional in-channel cells at the upper end of the 40-foot main ship channel adjacent to the Inner Confluence. Limited seismic reflection information prevents an estimate of cell depth so using adjacent cells as a guide it is tentatively estimated that six cells providing about 150,000 CY could be constructed.

Landfills, while significantly more expensive, would be an option that would not

require extensive environmental studies to accomplish. Landfills may be used if the amount of dredged material remaining is small. Also, in-channel disposal will be prioritized to accommodate Federal channel material first, then beneficiaries, and then non-beneficiary berths. The non-beneficiary berths may be required to use another option if in-channel disposal capacity is not available.

There is one CSO (BOS019) located within the Little Mystic Channel. It discharges from the southern bulkhead at the Chelsea St. Bridge. MWRA has no plans to decommission this CSO. Use of the Little Mystic channel for disposal of dredged materials would not prevent the use of this CSO for two reasons. First, a bulkhead constructed to contain the disposal area would be placed inshore (west) of the bridge, allowing the CSO to continue to discharge directly into the mouth of the Little Mystic channel. Second, the final depth of the site, once the disposed dredged material has been capped, would be 3 feet below mean low water (MLW), maintaining the subtidal nature of the site.

Little Mystic Channel would provide approximately 300,000 cy of space if needed. Material disposed in the Little Mystic Channel would be capped with clean material, thereby isolating the contaminated material now available for biological uptake. This alternative would maintain this area as subtidal habitat (-3 feet mlw), including a cap. Benthic, finfish and lobster studies have been performed at the Little Mystic Channel disposal site. No loss of functions and values of this site is anticipated.

USFWS is concerned that because of past fill operations in Boston Harbor the use of Little Mystic Channel could add to further degradation of the harbor. All of the in-channel cell capacity, additional cells in the upper main ship channel, and/or landfill sites would be used before Little Mystic Channel. It is recognized that additional studies, including reassessing alternative disposal plans, would be needed before Little Mystic Channel could be considered as a contingency site.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Field Office
22 Bridge Street, Unit #1
Concord, New Hampshire 03301-4986

May 10, 1996

Mr. Joseph L. Ignazio
Director of Planning
Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Mr. Ignazio:

This responds to your May 2, 1996 letter concerning the Boston Harbor Navigation Improvement Project, Boston, Massachusetts.

We have reviewed the New England Division responses to selected comments made by the Fish and Wildlife Service on the final environmental statement (EIS/EIR) for this project. The Corps Headquarters Office has requested further coordination between the agencies to insure that any outstanding issues are or can be resolved such that the project could move forward.

In our view, the responses to issues #8 and #11 on the issue paper attached to your letter are satisfactory and there is a reasonable likelihood that any concerns would be resolved during any subsequent permit process.

The NED response to issue #7 should be modified by incorporating a statement indicating that the Corps, EOEA, FWS and other agencies, if interested, would develop a mutually agreeable water quality monitoring plan during the 401 certification/CZM consistency process. If such a commitment is made by the Corps, then the Service would stipulate that the response was satisfactory and a reasonable likelihood exists that any concerns would be resolved during any future permitting process.

Any questions concerning this response should be directed to Mr. Vern Lang of this office at 603-225-1411.

Sincerely,

Kenneth C. Carr
Acting Supervisor
New England Field Office

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
One Blackburn Drive
Gloucester, MA 01930
MAY 13 1996

Joseph L. Ignazio
Director of Planning
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Mr. Ignazio:

The National Marine Fisheries Service (NMFS) has reviewed your May 2, 1996 letter transmitting the Corps' responses to resource agency comments on the Boston Harbor Navigation Improvement Project Final Environmental Impact Report/Statement (FEIR/S). We appreciate the opportunity to meet with your staff last month to discuss our comments and the Corps' preliminary responses, as well as the chance to review the Corps' final responses to be sure they address our agency's concerns. In our opinion, this type of coordination is extremely important to be sure that outstanding issues are not neglected as the Corps proceeds with final review and approvals for the project.

The Corps' responses to the National Oceanic and Atmospheric Administration's (NOAA) comments on the FEIR/S adequately address the majority of NOAA/NMFS' concerns, and we believe that the remaining issues can be resolved in a manner acceptable to NOAA, the Corps, and Massport during the state and federal permitting process for this project. However, we continue to recommend that the Corps make a stronger effort to coordinate this project internally between the Planning Directorate and the Regulatory Division. In particular, issues such as a fish monitor during construction (Issues #1 and #5) and the implementation of a monitoring program for the caps over in-channel disposal cells (Issue #10) could be handled in part through Section 10/404 permit conditions for the non-federal portion of the project. NMFS has raised this point repeatedly, but it is not clear whether project managers for the federal project have discussed such permitting options with Corps regulatory staff. Similarly, the proposed use of Little Mystic Channel as a contingency disposal site (Issue #11) would need to be evaluated through the permit process to identify less environmentally damaging practicable alternatives.

We look forward to continued coordination with the Corps on this project. If you have any questions about these comments, please contact Jonathan Kurland at (508) 281-9204.

Sincerely,

Chris Mantzaris
Chief, Habitat and Protected
Resources Division

cc: Karen Adams - ACOE
Vern Lang - USFWS
Phil Colarusso - EPA
Deerin Babb-Brott - MA CZM

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
JOHN F. KENNEDY FEDERAL BUILDING
BOSTON, MASSACHUSETTS 02203-0001

May 21, 1996

Joseph L. Ignazio
Director of Planning
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Mr. Ignazio,

This letter is in response to your May 2, 1996 letter concerning the Boston Harbor Navigation Improvement Project. EPA appreciates the opportunity to meet with your staff and discuss the issues raised by the federal resource agencies. As this is a complex project with many new regulatory issues, it is essential that this level of coordination continue between the agencies.

The majority of the issues have been resolved and EPA anticipates that the remaining issues will be adequately addressed through the permitting process. The remaining issues include the precise duties and skills of the on-board inspectors, the scope of the monitoring plan and the use of Little Mystic Channel as a contingency disposal site. The specifics of the monitoring plan and duties of the inspectors will be included as permit conditions. The use of Little Mystic Channel as a disposal site for dredge material would require the collection of additional information to demonstrate that this area is the least environmentally damaging practicable alternative.

EPA looks forward to continued coordination work with the Army Corps. Please contact Phil Colarusso of my staff at (617) 565-3533 with any questions about this project.

Sincerely,

David Fierra

David A. Fierra, Director
Office of Ecosystem Protection

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street, Boston, 02202

WILLIAM F. WELD
GOVERNOR
ARGEO PAUL CELLUCCI
LIEUTENANT GOVERNOR
TRUDY COXE
SECRETARY

Tel: (617) 727-9800
Fax: (617) 727-2754

April 29, 1996

Mr. Joseph Ignazio, Director of Planning
USACE/NED
424 Trapelo Road
Waltham, MA 02254-9149

RE: Boston Harbor Navigation Improvement Project (BHNIP)

Dear Mr. Ignazio:

The Executive Office of Environmental Affairs (EOEA) has reviewed the BHNIP materials provided in response to the April 11, 1996 meeting with Mr. Peter Jackson. The information has been provided to EOEA for the purpose of determining that there is a reasonable likelihood that our remaining concerns will be resolved in a manner acceptable to EOEA, Massport and the Corps of Engineers during the permitting process.

Based on a review of the information by the Department of Environmental Protection, the Division of Marine Fisheries, and Coastal Zone Management, EOEA has determined that there are no outstanding issues which cannot be resolved during the permitting process.

Please contact me if there is any other information you require.

Cordially,

Trudy Coxe

cc: Robert Gollege, Acting Director,
DEP Division of Wetlands and Waterways
Margaret M. Brady, Director MCZM
Leigh Bridges, Asst. Director,
Division of Marine Fisheries
Janeen Hansen, Project Manager
Massport
Peter Jackson, Project Manager,
USACE-NED

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
One Blackburn Drive
Gloucester, MA 01930

JAN 22 1996

Joseph L. Ignazio, Chief
Planning Division
US Army Corps of Engineers (COE)
424 Trapelo Road
Waltham, MA 02254-9149

Dear Mr. Ignazio:

This is in reference to your letter and Biological Assessment for the Boston Harbor Navigation Improvement Project (BHNIP), which initiated consultation under Section 7 of the Endangered Species Act (ESA). The NMFS concurs with your determination that the BHNIP will not be likely to adversely affect endangered and threatened species under NMFS jurisdiction or impact their critical habitat provided that certain conditions are implemented, as discussed in the Biological Assessment and previous Biological Opinions for the Massachusetts Bay Disposal Site (MBDS-NMFS, 1991a) and the Central Artery/Third Harbor Tunnel Project (CA/THT-NMFS, 1991b).

NMFS' initial concerns for marine resources centered on the uncertainty of disposing of contaminated silty material from the dredging project, the uncertainty of the efficacy of using caps at the MBDS to contain these contaminants, and the cumulative impacts of this project in conjunction with material from the CA/THT project. In addition, concerns were raised over the increase in barge/vessel traffic to and from the disposal site compared to normal annual levels and the possible increase in general vessel traffic into the harbor when the project was complete.

Since project plans have changed and only clean parent material will be disposed of at the MBDS, the concerns over contamination problems at the MBDS are no longer an issue for this project. The contaminated material will be disposed in-channel within the harbor and covered over with a clean sand cap. Endangered and threatened sea turtles and whales are not found in the channel or adjacent areas and the overlying layer of clean sand should be sufficient to contain any contaminated material buried below.

However, it is important to control the dredging process to maintain the integrity of separation of clean parent material from the contaminated silts. In our letter of August 29, 1995, we identified the concern that residual contaminated silt will be mixed with the parent clay material during the dredging process and be dumped at the MBDS. We continue to recommend that the COE attempt to quantify what fraction of the dredged

parent material (on a barge load basis) would be tainted by residual contaminated silt and inform us of the results before the actual dumping begins in 1997.

Other than water quality issues related to contamination, vessel traffic is the main concern for endangered and threatened whales that transit the MBDS. Hard-shelled sea turtles are extremely rare in the vicinity of MBDS and are not likely to be impacted by this project. Leatherback sea turtles are present, and while vessel collisions are remotely possible, it is highly unlikely that 8 barge loads a day at speeds less than 5 knots will adversely affect this species. There are two possible impacts, however, regarding vessel traffic and whales: 1) the short term impact of an increased number of disposal vessels traveling to and from the disposal site, and 2) increased use of the harbor (i.e. increase in number of large ships) .

While the MBDS is not a high use area, many individuals of endangered right whale, humpback and fin whale populations transit the area. Right whales, in particular, are extremely susceptible to vessel collision due to their propensity to rest, skim feed, and mate on the surface. Twenty percent of all right whale mortalities observed between 1970 and 1989 were caused by vessel collisions. Seven percent of the population exhibit prop wound scars indicating additional, non-lethal vessel interactions. It has been estimated that 19% of all vessel/right whale interactions are lethal (Kraus, 1990). An additional 5 known ship strikes causing three injuries and two mortalities have occurred since the aforementioned report. It is particularly important that vigilant observation be maintained aboard vessels during the period when right whales are most abundant in Cape Cod Bay, from the end of March though May. Other species of large whales also show scars indicating vessel interactions. Six of 18 humpback whales stranded in North Carolina and Virginia in recent years were identified as having been killed by vessel strikes (Wiley, 1995). Observers in the southeast have reported that whales have been known to closely approach dredging vessels.

Cooperation of vessel operators with trained endangered species observers greatly reduces the chance of whale/vessel interactions. Requiring the presence of trained observers in conjunction with the slow operating speeds of these disposal vessels (5 knots or less), allow us to conclude that the dredge and disposal operations associated with this project are not likely to adversely affect endangered whales. Right whales can travel at burst speeds of five-six knots, and humpback whales can easily avoid these slow moving vessels. Both the CA/THT and the MBDS consultations recommended that conservation measures be implemented that require NMFS-approved observers and special operating procedures when whales are in the vicinity of the operation. With the addition of further disposal operations from the BHNIP, this recommendation is even more vital to reducing the potential for impacts to these species and is part of the basis for our "not likely to adversely affect" determination. Since disposal for this project will be at the MBDS, all permits issued by the COE should include all five of the conservation recommendations listed in the MBDS consultation. Finally, your assessments have estimated that 8 barges per day will be traveling to and from the MBDS from both the BHNIP and CA/THT projects combined in 1997-1998. Should this estimate change, NMFS should be contacted to evaluate whether consultation should be reinitiated.

The other concern regarding vessel interactions is the possibility of increases in number of vessels coming to the Port of Boston because of the increased navigability this project will provide. Part of the conclusion of this consultation is based on your assertion that the number of vessels coming in and out of Boston Harbor should not increase, and may actually decrease, as a result of deepening the navigational channels. COE should carefully monitor this factor. Should new information become available that changes the basis for this conclusion (an increase in number of crossings are observed), or the basis for any other decision in this consultation, then consultation should be reinitiated.

Acoustic disturbance is one of the more elusive impacts possible from vessels and dredging operations such as BHNIP. Background noise in the ocean comes from many sources, but vessels are the major contributors (Richardson et al., 1995) . Marine dredging also creates underwater sound and can exceed ambient levels of sound out to considerable distances. Many reactions of marine mammals in the vicinity of vessels are presumed to be reactions to noise. However, very few controlled tests have been conducted that compare the reaction to that in the absence of vessels. Reactions are seen at long distances and follow changes in propeller speed. However, this dredging and disposal activity will result in 8 barge loads a day for 1997-1998, and thus will not be a continuous activity; this project will, therefore, have little influence on the level of background noise in Massachusetts Bay. Since the level of vessel traffic into and out of the Harbor is not expected to increase, noise levels should not increase. No information is currently available providing evidence that this disturbance is adversely affecting marine mammals or sea turtles in Massachusetts Bay. Since the most often observed reaction appears to be avoidance and the project is not in a high use area for whales, it is unlikely to have any adverse impact.

Finally, although not a part of the Section 7 consultation, we recommend that you address the issues raised in NMFS' August 29, 1995 comments on the FEIS before proceeding with the federal navigation project and prior to issuing a permit to Massport for the non-federal portions of the BHNIP. These issues include fish sampling at the in-channel disposal sites, contingency plans for disposal of material that cannot be contained in-channel, use of a qualified observer to monitor the project, and use of available technologies to reduce turbidity during in-channel operations. Attached are the conservation recommendations from the CA/THT and MBDS consultations for your reference and convenience.

If you have any further questions regarding this project, please contact Laurie Silva at (508) 281-9291 or Jon Kurland at (508) 281-9204.

Sincerely,

Dr. Andrew A. Rosenberg
Regional Director

Attachments

cc: F/PR - Bellmer, Payne
Mantzaris
K. Demos (COE)

NMFS, 1991(a) Biological Opinion for the Massachusetts Bay Disposal Site: Final Designation for Ocean Disposal. Northeast Region.

NMFS, 1991(b). Biological Opinion for the Central Artery Third Harbor Tunnel Project: Dredged Material disposal at the Massachusetts Bay Disposal Site. Northeast Region.

Richardson, W.J., C.R. Greene, C.I. Malma, and D.H. Thomson. 1995. Marine Mammals and Noise. Academic Press Inc. 576 pp.

Kraus, S.D. 1990. Rates and potential causes of mortality in North Atlantic right whales (*Eubalaena glacialis*). Marine Mammal Science. 6(4):278-291.

Wiley, D.N., R.A. Asmutis, T.D. Pitchford, D.P. Gannon. 1995. Stranding and mortality of humpback whales, *Megaptera novaeangliae*, in the mid-Atlantic and southeast United States, 1985-1992.

In addition to Section 7(a)2, which requires agencies to ensure that proposed projects will not jeopardize the continued existence of listed species, Section 7(a)1 of the ESA places an additional responsibility on all Federal agencies to: "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species...". NMFS is developing recovery plans for sea turtles and final plans for the northern right whale and humpback whale are being reviewed. These plans describe actions deemed necessary to achieve recovery and include implementation schedules that identify the Federal agencies best suited to address each recovery action. NMFS will advise and coordinate efforts toward achieving the goals of each plan. Copies of the northern right whale and humpback whale recovery plans will be forwarded to you by the Northeast Regional Office when they are available.

NMFS recommends that the following conservation measures be implemented to reduce adverse impacts to listed species.

(1) Disposal activities associated with the CA/THT may result in harassment, vessel collisions and exposure of endangered and threatened species to falling sediments (with small levels of contamination) and rock. In addition, sediments may impact some phytoplankton, zooplankton and fish species that are utilized by endangered species.

To minimize these risks, NMFS-approved observers should be on board disposal vessels during all disposal operations to identify and report the presence of listed species in the vicinity of the MBDS. Disposal vessels should not intentionally approach listed species closer than 100 feet when in transit. When species are present in the MBDS, vessels should, except when precluded by safety considerations, follow the advice of the on-board NMFS-approved observer to avoid direct impacts to individuals when releasing sediments at the disposal point. The on-board NMFS-approved observer should utilize the following guidelines to determine if disposal should be allowed in the presence of listed species. If listed species are sighted between a distance equal to twice the disposal vessel length and the disposal point, then release of sediments or rocks should be delayed until the animals move away from the disposal point. An alternative disposal buoy may be used, if available, when animals do not leave the primary disposal point. If visibility precludes the ability to sight listed species within a distance equal to twice the disposal vessel length, activities should be suspended until they improve. If listed species are sighted between a distance equal to twice the disposal vessel length and 1500 feet of the disposal point, the on-board NMFS-approved observer will note the animals's relative position, direction and speed of swimming, and behaviors

such as feeding or logging of whales to determine if release of sediments or rock is likely to harass or endanger the animals. For example, whales actively feeding at or near the disposal point are more likely to interact with the water column and thus released sediments than resting whales. If listed species are sighted at or beyond 1500 feet (1/4 nautical mile) of the disposal point, release of sediments or rock may proceed.

NMFS is currently reviewing regulations for the intentional approach of marine mammals. Should these regulations be implemented with stricter approach distances than Northeast Regional guidelines, these conservation recommendations will be modified accordingly.

(2) Corps personnel in charge of disposal monitoring should be in contact with NER Protected Species Staff regarding endangered species distributions and abundances in the region during disposal operations.

(3) Compliance with MARPOL V and the Marine Protection, Research and Sanctuaries Act of 1972, as amended, will reduce the effects of marine debris to listed species. Therefore, all project vessels over 26 feet in length should be displaying a MARPOL V sticker. All vessels over 40 feet must document their waste management plan to NMFS.

(4) Information is needed to sufficiently evaluate the additive, long-term impacts of disposal operations to the water quality of the MBDS and the Massachusetts Bay in general. The Corps should, in cooperation with the EPA, NMFS and the Commonwealth of Massachusetts conduct studies to adequately characterize the ambient levels of heavy metals and organics inside the boundaries of the MBDS and throughout Massachusetts Bay.

(5) Weather conditions may preclude the safe dumping of materials at the marker buoy. To ensure that disposal effects will be confined to the MBDS, on-board Corps inspectors should be given weather guidelines for exercising authority to suspend disposal operations before leaving port.

(6) Monitoring efforts should be implemented to verify the predictions of the ADDAMS DUMP model and ensure that disposal material remains contained within the MBDS circular boundary. Highest priority should be given to worst case conditions. Such data would establish confidence in the model's use for the MBDS.

(7) All agencies involved in activities that either contribute to the existing, or may add to the contaminant load in the Massachusetts Bay and Cape Cod Bay system, should be involved in a long-term testing program to monitor accumulated levels of key contaminants in free ranging endangered species. Historic tissue samples should also be tested when available to determine background levels of these chemicals.

CONSERVATION RECOMMENDATIONS

In addition to Section 7(a)(2), which requires agencies to ensure that proposed projects will not jeopardize the continued existence of listed species, Section 7(a)(1) of the ESA places an additional responsibility on all Federal agencies to: "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species....." NMFS is developing recovery plans for sea turtles, and final plans for the northern right whale and humpback whale are being reviewed. These plans describe actions deemed necessary to achieve recovery, and include implementation schedules that identify the Federal agencies best suited to address each recovery action. NMFS will advise and coordinate efforts toward achieving the goals of each plan. Copies of the northern right whale and humpback whale recovery plans will be forwarded to you by the Northeast Regional Office when they are available.

NMFS recommends that the following conservation measures be implemented to reduce adverse impacts to listed species. Similar measures were issued in the August 7, 1991, Biological Opinion to the Corps and Federal Highway Administration for the Central Artery/Third Harbor Tunnel Project. NMFS considers these recommendations applicable to all disposal projects that may be conducted at the MBDS. Thus, EPA should use its review authority to ensure that all permits issued by the Corps include conservation recommendations one through five. Additionally, a cooperative effort between EPA, the Corps, NMFS, Commonwealth of Massachusetts and all other agencies involved with potential environmental degradation of the MBDS is required to accomplish conservation recommendations six and seven. EPA should be the lead agency for these long-term studies.

(1) Disposal activities associated with the MBDS may result in harassment, vessel collisions and exposure of endangered and threatened species to falling sediments (with small levels of contamination) and rock. In addition, sediments may affect some phytoplankton, zooplankton and fish species that are utilized by endangered species.

To minimize these risks, NMFS-approved observers should be on board disposal vessels during all disposal operations to identify and report the presence of listed species in the vicinity of the MBDS. Disposal vessels should not intentionally approach listed species closer than 100 feet when in transit. When species are present in the MBDS, vessels should, except when precluded by safety considerations, follow the advice of the on-board NMFS-approved observer to avoid direct impacts to individuals when releasing sediments at the disposal point. The on-board

NMFS-approved observer should utilize the following guidelines to determine if disposal should be allowed in the presence of listed species. If listed species are sighted between a distance equal to twice the disposal vessel length and the disposal point, then release of sediments or rocks should be delayed until the animals move away from the disposal point. An alternative disposal buoy may be used, if available, when animals do not leave the primary disposal point. If visibility precludes the ability to sight listed species within a distance equal to twice the disposal vessel length, activities should be suspended until they improve. If listed species are sighted between a distance equal to twice the disposal vessel length and 1500 feet of the disposal point, the onboard NMFS-approved observer will note the animals' relative position, direction and speed of swimming, and behaviors such as feeding or logging of whales to determine if release of sediments or rock is likely to harass or endanger the animals. For example, whales actively feeding at or near the disposal point are more likely to interact with the water column and thus released sediments than resting whales. If listed species are sighted at or beyond 1500 feet (1/4 nautical mile) of the disposal point, release of sediments or rock may proceed.

NMFS is currently reviewing regulations for the intentional approach of marine mammals. Should these regulations be implemented with stricter approach distances than Northeast Regional guidelines, these conservation recommendations will be modified accordingly.

(2) EPA and Corps personnel in charge of disposal monitoring should be in contact with NER Protected Species Staff regarding endangered species distributions and abundances in the region during disposal operations.

(3) Compliance with MARPOL V and the Marine Protection, Research and Sanctuaries Act of 1972, as amended, will reduce the effects of marine debris to listed species. Therefore, all project vessels over 26 feet in length should be displaying a MARPOL V sticker. All vessels over 40 feet in length must document their waste management plan to NMFS.

(4) Monitoring efforts should be implemented to verify the predictions of the ADDAMS DUMP model and ensure that disposal material remains contained within the MBDS circular boundary. Highest priority should be given to worst case conditions. Such data would establish confidence in the model's use for the MBDS.

(5) Weather conditions may preclude the safe dumping of materials at the marker buoy. To ensure that disposal effects will be confined to the MBDS, onboard Corps inspectors should be given weather guidelines for exercising authority to suspend disposal operations before leaving port.

(6) Information is needed to evaluate sufficiently the additive, long-term impacts of disposal operations to the water quality of the MBDS and the Massachusetts Bay in general. EPA should, in cooperation with the Corps, NMFS and the Commonwealth of Massachusetts, conduct studies to adequately characterize the ambient levels of heavy metals and organics inside the boundaries of the MBDS and throughout Massachusetts Bay.

(7) All agencies involved in activities that either contribute to the existing, or may add to the contaminant load in the Massachusetts Bay and Cape Cod Bay system, should be involved in a long-term testing program to monitor accumulated levels of key contaminants in free-ranging endangered species. Historic tissue samples should also be tested when available to determine background levels of these chemicals.

INCIDENTAL TAKE

Section 7(b)(4) of the ESA requires that when an agency action is found to comply with Section 7(a)(2), NMFS will issue a statement specifying the impact of incidental taking of endangered species, providing reasonable and prudent measures necessary to minimize impacts, and setting forth the terms and conditions that must be followed.

The action of final designation of the MBDS should not result in the direct take of any endangered or threatened species under NMFS juriadiction. Furthermore, all disposal at the MBDS will involve additional Federal action by the Corps or other action agencies. Section 7 consultation regarding these actions will provide incidental take statements for the scope of each project. Accordingly, an incidental take statement is not being issued for this Biological Opinion.

D. Stellwagen Bank Marine Sanctuary Consultation Letter

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
OCEAN AND COASTAL RESOURCE MANAGEMENT
SANCTUARIES AND RESERVES DIVISION
Stellwagen Bank National Marine Sanctuary
14 Union Street
Plymouth, Massachusetts 02360
(508) 747-1691 (508) 747-1949 FAX

23 February, 1996

Joseph L. Ignazio, Director of Planning
Planning Directorate
New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254-9149

Dear ~~Mr. Ignazio~~:

In response to your letter dated 11 January, 1996, I want to confirm that you have completed the formal consultation process, as provided for in the National Marine Sanctuaries Act, with our office. If this project is modified in a manner that would change the way in which the Sanctuary may be affected by the action, please contact my office to re-open the consultation.

I would be happy to meet with your staff to answer any questions they might have regarding the consultation process. Please have Ms. Demos give me a call to arrange a date and time.

Sincerely,

Bradley W. Barr
Sanctuary Manager

FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
FOR
DEEP-DRAFT NAVIGATION IMPROVEMENTS
TO
BOSTON HARBOR INCLUDING
MYSTIC RIVER, CHELSEA RIVER, AND RESERVED CHANNEL

SYLLABUS

This report which examines the feasibility of Federal participation in providing modifications to the existing Federal navigation project in Boston Harbor and the Mystic River, Massachusetts was prepared in response to two Congressional Resolutions.

The investigation focused on the feasibility of providing greater depths in the three major tributary navigation channels in the harbor, the Mystic River, Chelsea River, and Reserved Channel, now 35 feet deep at Mean Low Water (MLW). The Reserved Channel and Mystic River would be deepened to 40 feet MLW, the same depth that now exists in the Inner Harbor Main Ship Channel. As part of the Mystic River improvement, the Inner Confluence which provides access to the Mystic and Chelsea River Channels would be also widened and deepened to 40 feet. To ease maneuvering difficulties and increase navigational safety the Reserved Channel would be widened at its confluence with the Main Ship Channel. The Chelsea River Channel would be deepened to 38 feet MLW.

These improvements would increase the navigational efficiency and safety of harbor operations and most importantly would eliminate or reduce tidal delays for larger vessels. The current practice of waiting for favorable tides in the bay or anchorage would no longer be necessary or be reduced for most classes of vessels. More frequent use of larger classes of vessels with tidal assistance would result.

The straightening, widening and deepening of the principal harbor entrance, the Broad Sound North Channel, was also examined as requested by harbor users. This improvement as well as widening of the Inner Harbor's Main Ship Channel, were found to be unnecessary at this time since projected traffic volumes will not require two-way traffic.

To increase the size of the Presidents Roads Anchorage at no cost, a nonstructural feature of the recommended plan was also identified. This feature would declare specific Federal channel limits through the Roads to connect the outer confluence of the three entrance channels with the Main Ship Channel. It would allow the expansion of the anchorage 450 feet southward into waters 40 to 60 feet deep MLW and slightly eastward toward Deer Island Light. The anchorage would thus be increased by over 70 acres or about 20 percent by the relocation of existing buoy markers.

The estimated combined cost of the proposed trubitary channel improvements, based on August 1988 price levels, is $24,490,000 including $1,530,000 for berthing area deepening at the terminals of project beneficiaries on all three channels and $130,000 for utility relocations on the Chelsea River. Annual costs of $2,331,000 when compared to annual benefits of $5,473,000 yield net annual benefits of $3,142,000 and a benefit-cost-ratio of 2.3.

The Massachusetts Port Authority has indicated a willingness to act as sponsor for this project. Final implementation of this project would be subject to approval by the Assistant Secretary of the Army. A Ship Simulation Study will be performed to aid in final design. The Federal share of project costs is estimated at $14,850,000. The non-Federal cost share is presently estimated $9,650,000. The non-Federal share consists of 25 percent of the cost of channel deepening to be paid up-front ($5,710,000), 10 percent of such costs to be repaid over a period of up to 30 years ($2,280,000) plus the berthing area deepening costs and utility relocation costs identified above.

BOSTON HARBOR, MASSACHUSETTS

FEASIBILITY REPORT FOR NAVIGATION IMPROVEMENT

EXECUTIVE SUMMARY TABLE

	Deepening to 40 feet		Deepen to 38 feet	
	Reduced Length Reserved Channel	Mystic River Channel and Inner Confluence	Chelsea River Channel	Combined Tributary Plan
Dredging Quantity (CY)				
Ordinary Material	438,000	1,145,000	455,000	2,038,000
Rock	40,000	54,000	none	94,000
First Cost of Construction	$7,952,000	$12,211,000	$4,013,000	$22,821,000
Navigation Aids Relocation	none	4,000	8,000	12,000
(Interest During Construction)*	(144,000)	(357,000)	(28,000)	(914,000)
Local Berthing Deepening	122,000	1,002,000	403,000	1,527,000
Utility Relocation	none	none	130,000	130,000
TOTAL COST	$8,074,000	$13,220,000	$4,554,000	$24,490,000
Annual Cost	729,000	1,260,000	427,000	2,331,000
Annual Benefits	3,068,000	1,803,000	602,000	5,473,000
Net Benefits	2,339 000	543,000	175,000	3,142,000
Benefit/Cost Ratio	4.2	1.4	1.4	2.3
Cost Apportionment				
Federal Cost				
65% of first cost	5,169,000	7,937,000	2,608,000	14,834,000
Navigation Aids	none	4,000	8,000	12,000
TOTAL	$5,170,000	$7,940,000	$2,620,000	$14,850,000
Local Cost				
Local Up-Front (25%)	1,988,000	3,053,000	1,003,000	5,710,000
Local Pay-Back (10%)	795,000	1,221,000	401,000	2,280,000
Local Berthing	122,000	1,002,000	403,000	1,530,000
Local Utility Relocation	none	none	130,000	130,000
TOTAL	$2,910,000	$5,280,000	$1,940,000	$9,650,000

* Not included in Project Costs.

ADDENDUM
TO THE
BOSTON HARBOR, MASSACHUSETTS
FEASIBILITY REPORT FOR NAVIGATION IMPROVEMENT
(September 1988)

Following preparation of the revised Feasibility Report and Environmental Assessment in August 1988, additional information was received relative to containership benefits for the Reserved Channel and the lower Mystic River Channel. Additional costs were also developed for the Chelsea River Channel to address the possibility of a need to provide additional protection to the Boston Gas Company's natural gas siphon crossing. The late receipt of this information did not allow for its inclusion in the revised final report. The new information and its effect on the proposed plan is discussed below. However, it must be noted that this was determined to have no effect on either the plan formulation process or the recommendation.

Containership benefits at either the Reserved Channel's Conley Terminal (Sealand) or the Mystic River's Moran Terminal (Maersk) will take the form of either tidal delay reductions or reduced lightloading requirements. Shippers are presently unable to determine which would be the case. Presently the need to keep to schedules is of primary importance forcing shippers to lightload in order to ensure scheduling. The Sealand-Ned Lloyd-TFL service is only 4 months old and the Maersk Service is expected to begin within several months. Analysis of these benefits is therefore in its early stages. With the expected near-term growth in cargo it is not possible at this early stage of analysis to determine to what extent, if any, that acceptance of tidal delay may replace lighloading practices. Because of this uncertainty it was decided to present continership benefits as a range. Tidal delay benefits, including off-water benefits, represent the low end of the range should shippers deterime that maximum delays are acceptable. The full elimination of lightloading represents the high end of the range that would accrue should the need to maintain schedules despite the cost remain paramount.

With the 38-foot depth recommended for the Chelsea River Channel, including the use of controlled dragline dredging to reduce overdepth in sensitive areas, the Boston Gas siphon crossing need not be lowered from its 40.5 foot depth. However, vessel wakes may over time remove some of the remaining overburden through erosion and prop wash. In order to protect against such a possiblity, it may be necessary to place a protective cap, mat or fill over the siphon crossing to eliminate the potential for erosion. Though only a small amount of material need be removed to place any protection, such extreme care must be taken that high unit-costs would result for excavation. A total cost of about $500,000 would be added to the utility relocation costs for the Chelsea River Channel.

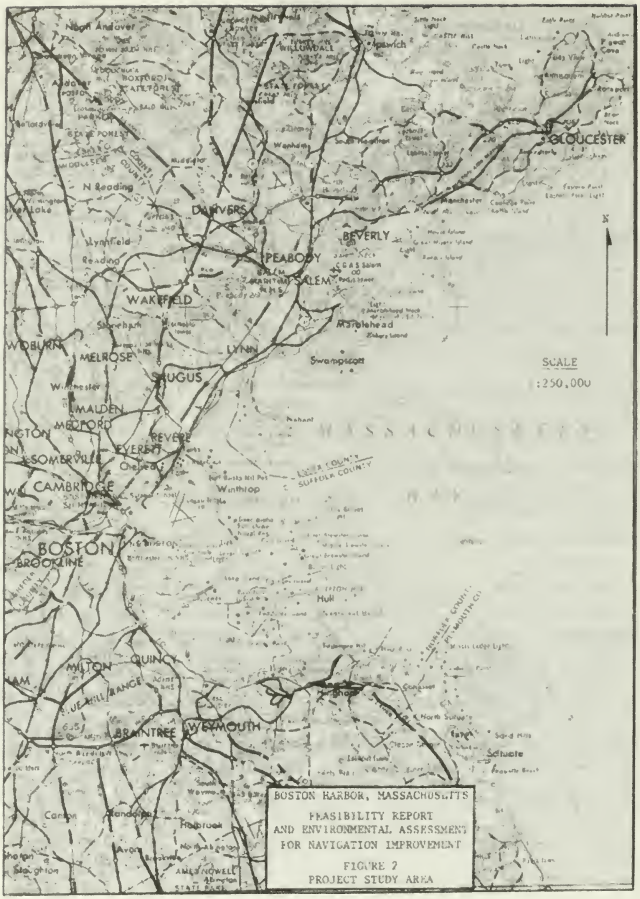
The effect of these additional costs and the range of containership benefits on the individual tributary channel plans and the overall recommendation are shown in the following table.

ADDENDUM
TO THE
BOSTON HARBOR, MASSACHUSETTS
FEASIBILITY REPORT
FOR NAVIGATION IMPROVEMENT

(Septmeber 1988)

	Deepening to 40 feet		Deepen to 38 feet	
	Reduced Length Combined Channel	Mystic River Channel and Inner Confluence	Chelsea River Channel	Combined Tributary Plan
First Cost of Construction				
General Navigation Facilities	$7,952,000	$12,211,000	$4,013,000	$22,821,000
Navigation Aids Relocation	none	4,000	8,000	12,000
Local Berthing Deepening	122,000	1,002,000	403,000	1,527,000
Utility Relocations & Mod	none	none	630,000	630,000
TOTAL COST:	$8,074,000	$13,220,000	$5,054,000	$24,990,000
Interest During Construction	$ 144,000	$ 357,000	$ 28,000	$ 914,000
Annual Cost	$ 729,000	$ 1,260,000	$ 471,000	$ 2,375,000
With High End Containership Benefits				
Annual Benefits	$4,485,000	$3,323,000	$ 602,000	$ 8,410,000
Net Annual Benefits	3,756,000	2,063,000	131,000	6,035,000
Benefit/Cost Ratio	6.2	2.6	1.3	3.5
With Low End Containership Benefits				
Annual Benefits	$1,642,000	$1,972,000	$ 602,000	$4,216,000
Net Annual Benefits	913,000	712,000	$ 131,000	1,841,000
Benefit/Cost Ratio	2.3	1.6	1.3	1.8
Cost Apportionment				
Federal Cost				
65% of GNF	$5,169,000	$7,937,000	$2,608,000	$14,834,000
Navigation Aids	none	4,000	8,000	12,000
TOTAL:	$5,170,00	$7,940,000	$2,620,000	$14,850,000
Local Cost				
25% of GNF Up-front	$1,988,000	$3,053,000	$1,003,000	$5,710,000
10% of GNF Pay-back	795,000	1,221,000	401,000	2,280,000
Local Berthing Deepening	122,000	1,002,000	403,000	1,530,000
Utility Relocation & Mod.	none	none	630,000	630,000
TOTAL	$2,910,000	$5,280,000	$2,440,000	$10,150,000

NOTE: Costs and economic impacts for the three separable tributary plans are shown for each as individual projects. The combined plan costs and impacts are provided for all three modifications constructed under a single contract.


North Andover
Haverhill
Ipswich
GLOUCESTER
N Reading
DANVERS
BEVERLY
PEABODY
SALEM
WAKEFIELD
Marblehead
WOBURN
MELROSE
LYNN
Swampscott
SAUGUS
SCALE
:250,000
MALDEN
MEDFORD
REVERE
EVERETT
SOMERVILLE
CAMBRIDGE
Winthrop
BOSTON
BROOKLINE
Hull
MILTON
QUINCY
BRAINTREE
WEYMOUTH
Scituate
Canton
Randolph
Holbrook
Avon
Stoughton
ABINGTON
BOSTON HARBOR, MASSACHUSETTS
FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT
FIGURE 2
PROJECT STUDY AREA

BOSTON HARBOR
BOSTON, MASSACHUSETTS
FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

INTRODUCTION

The Port of Boston, Massachusetts, as shown in Figure 1, is located on the western side of Massachusetts Bay, approximately 50 nautical miles northwest of the tip of Cape Cod. Its outer and inner harbors include all the tidal waters bounded by a line drawn roughly from Point Allerton in Hull, northward to Point Shirley in Winthrop. The harbor comprises a water area of approximately 47 square miles.

Boston Harbor is home to one of the United States' oldest and most historic international trading centers, the Port of Boston. A source of jobs and commerce for the 13 million residents of the six-state New England region, the Port handles more than 25 million tons of cargo, worth more than $7 billion, annually.

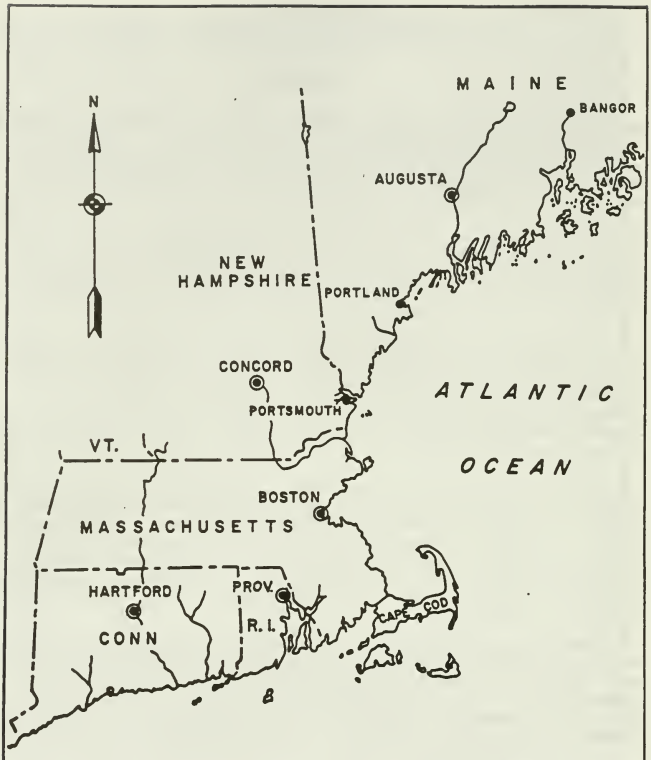
Bulk products including petroleum, natural gas, cement, scrap metal, and salt are processed through the Port's 23 private terminals. The remaining high value general cargo, 87 percent of which is containerized, is handled by the three public terminals owned and operated by the Massachusetts Port Authority (Massport). They include Moran Container Terminal in Charlestown and the Conley and Harbor Gateway Terminals, both in South Boston.

The Port of Boston has always been, and continues to be, a vital element in the social and economic welfare of the Commonwealth of Massachusetts and the entire New England region. The industrial and commercial life of the region is immeasurably interwoven with harbor activity. A favorable geographic location, its network of major highways, airport and railroad facilities, and its available work force, make Boston the logical distribution center for the thickly populated and highly industrialized area that surrounds it.

The main deep water harbor is comprised of the waterways of the Main Ship Channel, Reserved Channel, Chelsea River, and Mystic River. Deep water access to the harbor is provided by three entrance channels constructed by the Corps of Engineers. These channels are; the Broad Sound North Channel, in two lanes at 35 and 40 feet; the Broad Sound South Channel at 30 feet and The Narrows Channel at 27 feet.

Terminals located in the harbor complex shipped and received over 21 million tons of liquid and dry bulk, containerized, and general cargo in 1986.* Vessel traffic and the location of major terminals have changed considerably in recent years. With larger, deeper draft vessels entering the world fleet, there is a growing need for port development to assist in regional economic growth.

*Waterborne Commerce Statistics - 1986, Water Resources Support Center



BOSTON HARBOR, MASSACHUSETTS
FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT

FIGURE 1
PROJECT LOCATION

In the period between 1917 and 1945, deep-draft improvements involved dredging the Main Ship Channel and the Broad Sound North Entrance Channel to -40 feet MLW. During that period the port's major commercial activity took place along the Main Ship Channel shoreline of East Boston, Charlestown, and South Boston. Since those improvements, use of these areas has changed. The downtown Boston waterfront except for the Charles River has been declared non-navigable and no longer berths deep draft vessels. Most of East Boston's waterfront facilities are no longer used for deep-draft traffic, although recent purchases of several facilities by the Massachusetts Port Authority (Massport) could contribute toward expanded marine-commercial activity. Most of the Charlestown waterfront is being transformed into recreational marinas, museums, retail or residential use. Much of the South Boston waterfront is being developed for purposes other than deep-draft navigation.

Deep-draft navigation in Boston Harbor is presently based in the three major tributaries of the harbor, namely the Mystic River, Chelsea River, and Reserved Channel as well as along the remaining industrial waterfront of South Boston. The tributary channels have all been improved in the past by the Corps of Engineers to a depth of 35 feet. As this depth limits deeper draft traffic to tidal passage, the 40-foot improvements to the Entrance Channel and Main Ship Channel are thus underutilized.

Local navigation interests, via Congressional Resolutions, have requested that the Corps of Engineers determine the feasibility of government participation in the improvement of the accessibility of Boston Harbor for the current and future domestic and world fleets. This report describes the results of the study performed by the Corps in response to their requests.

STUDY AUTHORITY

Local interests believe that modifications to the harbor could be justified due to the increase of bulk commodities flowing through the port, and the delay time being experienced by larger vessels requiring a high tide to negotiate the ship channels into the port.

In response to the requests of local interests, the Congress of the United States directed the Corps of Engineers to study and report on the present and projected navigation needs in Boston Harbor. Specific authority is contained in two separate resolutions adopted by the Committee on Public Works of the United States Senate, on 1 March 1968 and 11 September 1969. The resolutions request the Board of Engineers for Rivers and Harbors to review the reports of the Chief of Engineers on Boston Harbor, Massachusetts, published as House Document Number 733, Seventy-Ninth Congress, and prior reports with a view to determining whether the existing project should be modified. Both resolutions are given in their entirety below:

"RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, (March 1, 1968), That the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby requested to review the report of the Chief of Engineers on Boston Harbor, Massachusetts, published as House Document Numbered 733, Seventy-ninth Congress, and other pertinent reports, with a view to determining the advisability of deepening the existing 35-foot Main Ship Channel, to a depth commensurate with the adjacent 40-foot Main Ship Channel, extending from deep water in President Roads to the Fish Pier at South Boston, in order to provide overall project dimensions of 40 feet by 1200 feet in this reach of the Main Ship Channel."

"RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, (September 11, 1968), That the Board of Engineers for Rivers and Harbor, created under Section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby requested to review the report of the Chief of Engineers on Boston Harbor, Massachusetts, published as House Document Numbered 733, Seventy-ninth Congress, and other pertinent reports, with a view to determining whether any modifications of the recommendations contained therein are advisable at this time, with particular reference to modifying the project dimensions of the Main Ship Channel from deep water in Broad Sound to the upstream limit of the Federal project in the Mystic River."

SCOPE OF THE STUDY

The scope of study entailed an investigation of the navigation project at Boston Harbor, and the formulation and evaluation of alternative measures for improving navigation conditions in the harbor. The first congressional authorization for the project review, 1 March 1968, was specific in directing the scope of the study. That resolution requested a review of the Boston Harbor Navigation Project with a specific view to determining the advisability of a 1200 x 40 foot channel from President Roads to the South Boston Fish Pier. The second resolution, adopted 11 September 1969, widened the scope of the study to the possible improvement of the entire Federal project in Boston Harbor. This resolution requested that the Main Ship Channel be studied from deep water in Broad Sound to the upstream limit of the Federal project in the Mystic River, for the modification of project dimensions.

The scope of the study involves an iterative process to develop alternative plans of improvement. Identification of local resource management problems and needs was made by obtaining input from local interests at public meetings, through correspondence and informal meetings and site visits. Baseline studies of the area were performed, including the natural environment, human resources, economy and development of the region. Possible management measures for improving these base conditions were identified. Formulation of alternative plans of improvement were based upon the various management measures. Comparative evaluations were made of the alternative plans of improvement. Criteria for evaluation of

plans were based on engineering, economic, social and environmental considerations. Selection of a plan was performed by comparing the costs, benefits and environmental impacts of the various proposed alternatives. A plan was then selected which optimizes economic and environmental factors and best meets the planning objectives identified for this study.

This feasibility report represents the results of the Corps of Engineers planning process with regard to the Boston Harbor Navigation Improvement Study in response to the study authority. Implementation of a plan of improvement for Boston Harbor channels can be performed upon approval by the Congress and local interests, and when funding can be appropriated, by both the Federal Government and the local sponsor.

STUDY PARTICIPANTS AND COORDINATION

During the course of this study, coordination was maintained with the following Federal, regional, State, and local agencies:

Federal Agencies

U.S. Environmental Protection Agency
U.S. Coast Guard
U.S. Maritime Administration
National Park Service
Bureau of Outdoor Recreation
U.S. Public Health Service
National Marine Fisheries Service
U.S. Fish and Wildlife Service
Economic Development Administration
U.S. Geological Survey
Federal Highway Administration
Federal Aviation Administration

Regional Commissions
(no longer in existance)

New England Regional Commission
New England River Basins Commission (no longer in existence)
New England Interstate Water Pollution Control Commission

State Agencies

Mass. Executive Office of Environmental Affairs (EOEA)
Mass. Dept. of Environmental Management (MADEM)
Mass. Dept. of Public Works
Mass. Office of Coastal Zone Management (MACZM)
Mass. Turnpike Authority
Mass. Dept. of Environmental Quality Engineering (MADEQE)
Mass. Pilots Commission
Mass. Historical Commission
Mass. Water Resources Authority (MWRA)
Metropolitan District Commission (MDC)
Mass. Bay Transportation Authority (MBTA)
Massachusetts Port Authority (Massport)

Local Communities and Agencies

Boston Redevelopment Authority (BRA)
Boston Conservation Commission
Boston Harbormaster
Boston Economic Development and Industrial Corporation (EDIC)
Boston Harbor Commission

Town of Hull	City of Quincy
Town of Hingham	City of Revere
Town of Weymouth	City of Chelsea
Town of Winthrop	City of Everett

Interested Organizations

Boston Harbor Associates
Maritime Association of Greater Boston
Metropolitan Area Planning Council (MAPC)
Boston Marine Society
Boston Harbor Pilots Association
Propeller Club of the United States - Port of Boston
American Institute of Merchant Shipping
Everett Chamber of Commerce

Harbor Users

Independent Cement	Boston Pilots
Exxon USA	Belcher New England, Inc.
Massport	Boston Fuel Transportation Inc.
Boston Edison	White Fuel Corporation
Distrigas of Massachusetts	U.S. Gypsum Company
Boston Towboat Company	Boston Gas Company
Mobil Oil Corporation	Gibbs BP Corp.
Northeast Petroleum Corp.	Global Petroleum
Gulf Oil	Blue Circle-Atlantic Cement
Sealand Services, Inc.	

Coordination was also maintained with all concerned State, local or regional interests and all private groups and individuals who expressed an interest in this study. Information exchange and coordination was accomplished through workshops, mailings, formal public meetings, study progress briefings and distribution of reports as needed to maintain an effective public involvement program. A listing of hearings and other meetings is contained in Appendix 4.

PRIOR STUDIES AND REPORTS

Boston Harbor has been the subject of the numerous reports since 1825, from which time to 1866, the projects adopted were intended to preserve the harbor by protecting the surrounding headlands and islands by constructing seawalls, aprons, and jetties. The three entrance channels, President Roads Anchorage, Inner Harbor Main Ship Channel, and Tributary Channels were authorized by subsequent congressional actions. The basis for the existing project can be found as a report in House Document number 733, 79th Congress, 2nd session. A chronology of authorizing legislation and Federal reports is listed in the following table and a detailed history of the development of the Federal project is contained in Appendix 1.

TABLE 1
AUTHORIZING LEGISLATION OF EXISTING PROJECTS
IN BOSTON HARBOR, MASSACHUSETTS

BOSTON HARBOR

ACTS	WORK AUTHORIZED	DOCUMENTS AND REPORTS
Mar 2, 1825	Preservation of islands by seawalls	----
June 14, 1880	Weir River (Nantasket Beach Channel) 9-1/2 ft. deep, 100 ft wide to Steamboat Wharf at Nantasket.	
Sept 19, 1890	Weir River (Nantasket Beach Channel) 9-1/2 ft. deep, 150 ft. wide to Steamboat Wharf at Nantasket.	----
July 25, 1892	Weir River (Nantasket Beach Channel) from mouth of Weir River to Steamboat Wharf at Nantasket Beach 12 ft. deep, 150 ft. wide.	----
Aug 5, 1886	Fort Point Channel - 23 ft. deep	H. Ex. Doc. 206, 48th Cong. 2d Sess. Annual Rept., 1885 p. 543.
	Nubble Channel-15 feet deep between Long Island and Nixes Mate Shoal.	Annual Report, 1887 p.517
July 13, 1892	Narrows Channel -27 ft. deep from Hantasket Roads to President Roads	Annual Report, 1893, p. 766
Mar 3, 1899	Broad Sound South - 30-ft. channel from sea to President Roads through Broad Sound by less direct route than later 35-and 40-foot channels.	H. Doc. 133, 55th Cong., 2d Session
June 13, 1902	For 35-foot channel from sea via Broad Sound North route to Boston Naval Shipyard, Chelsea and Charles River Bridges.	H. Doc. 119, 56th Cong, 2d sess. Annual Report, 1901, p. 1096
	Elimination from project of removal of Finns Ledge at outer entrance.	Authorized by Chief of Engineers, Mar 11, 1913
Aug 8, 1917	Depth of 40 feet (45 feet in rock) in Broad Sound North Entrance Channel.	H. Doc. 931, 63d Cong., 2d Session
Aug 30, 1935	Present project dimensions of channel from President Roads to Commonwealth Pier No. 1, East Boston and anchorage area north side of President Roads.	H. Doc. 244, 72d Cong 1st Session
Do....	Present project dimensions of that part of approach channel to U.S. Navy drydock No. 3 at South Boston between Main Ship Channel and U.S. harbor line.	Rivers & Harbors Committee Doc. 29, 74th Cong., 1st Session
Aug 26, 1937	Chelsea River Channel, 30 feet deep	Rivers & Harbors Committee Doc. 24, 75th Corng. 1st Session

BOSTON HARBOR (Continued)

ACTS	WORK AUTHORIZED	DOCUMENTS AND REPORTS
Sept 7, 1940	Abandons seaplane channel authorized in 1940 River & Harbor Act (H. Doc 262, 76th Cong., 1st sess.)	Public Law 420, 78th Cong.
Oct 17, 1940	Reserved Channel 30 feet deep	H. Doc. 255, 76th Cong., 1st Session
Mar 2, 1945	Extension of 40-foot channel	H. Doc. 733 79th Cong., 2d Session
July 24, 1946	Extension of President Roads anchorage	H. Doc. 244, 80th Cong. 1st Session
July 3, 1958	Reserved Channel 35 feet deep, 430 feet wide, extending 1 mile from 40-foot Main Ship Channel to L St.	H. Doc 349, 84th Cong.
Oct 23 1962	Chelsea River Channel and Maneuvering Basin 35 feet deep	H. Doc. 350, 87th Cong., 2d Session
Dec 31, 1970	Deauthorizes Fort Point Channel above Summer Street (also PL-91-624)	----
Dec 29, 1981	Deauthorizes Fort Point Channel above Northern Avenue (also PL-97-128, Section 4'c))	Sen. Doc. 1493, 97th Cong. 1st Session

MYSTIC RIVER

Acts	Work Authorized	Documents & Reports
July 13, 1892	Channel 6-feet then 4 feet deept in Upper Mystic to Medford	Annual Report 1891 page 672
March 3, 1899	25-foot channel in Lower Mystic up to Island End River	H. Doc. 1178 55th Congress 3rd Session
June 25, 1910	30-foot Channel in Lower Mystic up to Island End River	H. Doc. 1086 60th Congress 2nd Session
Aug 30, 1935	Extend 30-foot Channel to Malden Bridge	RAH Committee H. Doc. 833 74th Congress 1st Session
June 20, 1938	20-foot Channel thru Malden Bridge to turning basin at Somerville	H. Doc. 1542 75th Congress 3rd Session
May 17, 1950	35-foot Channel in Lower Mystic from Boston Harbor, 600 to 1060 feet wide	H. Doc. 1645 80th Congress 2nd Session

TABLE 1

BOSTON HARBOR VICINITY
OCEAN
MASSACHUSETTS

LOCATION MAP
35 FT WEYMOUTH FORE RIVER CHANNEL
POINT ALLERTON AREA
BOSTON HARBOR, MASS
35 FT CHANNEL
40 FT CHANNEL
30 FT CHANNEL
27 FT NARROWS CHANNEL
40 FT APPROACH CHANNEL
40 FT ANCHORAGE EXTENSION
35 FT RESERVED CHANNEL
35 FT AREA
40 FT ANCHORAGE
35 FT NARROWS CHANNEL
40 FT CHANNEL
18 FT DORCHESTER BAY CHANNEL
35 FT WEYMOUTH FORE RIVER CHANNEL
35 FT WEYMOUTH FORE RIVER CHANNEL
MYSTIC RIVER
CHELSEA CREEK
CHELSEA
EAST BOSTON
BOSTON
SOUTH BOSTON
DORCHESTER
QUINCY
HINGHAM
HULL
NANTASKET ROADS
PEDDOCKS ISLAND
GEORGES ISLAND
SLATE ISLAND
GREAT BROWER
LONG ISLAND
THOMPSONS ISLAND
BOSTON LIGHT
NANTASKET BEACH
HULL

PROBLEM IDENTIFICATION

This section of the report describes the existing conditions in the study area and evaluates these conditions together with the probable future conditions likely to occur without Federal participation in navigation improvements. The existing and potential navigational problems resulting from these conditions are identified, and potential opportunities for their solution discussed. Planning constraints which may impact the formulation of solutions are identified. The planning objectives to be met through the formulation of alternative plans were developed from these analyses.

EXISTING CONDITIONS

A general understanding of the existing resources, development, and economy of the study area is essential in identifying the problems and needs of Boston Harbor and in selecting appropriate alternative management plans. The following paragraphs outline the environmental, natural, human and economic resources of the Boston Harbor area, with particular emphasis on existing and potential commercial and vessel movements that effect the Port of Boston.

Environmental Setting and Natural Resources

Boston Harbor is one of the better natural harbors on the eastern seaboard and is the site of the largest city in New England. Located in the northeastern section of Suffolk County on Massachusetts Bay, the harbor is on the east coast of the Commonwealth of Massachusetts approximately 223 highway miles northeast of New York City, and 103 highway miles south of Portland, Maine as shown in Figure 1. Figure 2 shows the location of the port along with the primary study area served by the harbor and the Port of Boston.

Geological Setting

The harbor is part of the Boston Basin, a lowland area surrounded by a ridge of bedrock which was created millions of years ago. The recession of glacial ice at the end of the ice age left a number of drumlins, (smooth rounded hills) around the harbor. Most of the harbor islands and the sites of some famous historic landmarks, such as Bunker Hill, are drumlins. The shoreline is very irregular and reflects the effects of geological forces and manmade alterations. Continuous erosion by the sea and wind has resulted in a considerable size reduction in several of the islands, culminating in the complete disappearance of some, such as Nixes Mate and Bird Island. A major portion of the land surrounding the harbor, particularly areas within the city Boston, was created by landfill operations undertaken by the Commonwealth between the 1830's and 1920.

Geographic and Institutional Setting

The harbor is bordered by twelve municipalities. Proceeding clockwise from the South, these are the towns of Hull, Hingham, Weymouth, and Braintree; the cities of Quincy, Boston, Cambridge, Somerville, Everett, Chelsea and Revere; and the town of Winthrop.

The Port of Boston is composed of an inner and outer harbor. The Inner Harbor, which lies north and west of a line drawn between Logan Airport in East Boston and Castle Island in South Boston, as shown in Figure 3, includes the mouths of the Reserved Channel and Fort Point Channel, and the Charles, Mystic and Chelsea Rivers. The Outer Harbor is divided into the four Bays of Winthrop, Dorchester, Quincy and Hingham which receive most of the tributary waters flowing into the harbor. Proceeding counter-clockwise from the southern tip of Castle Island are Dorchester Bay into which empties the Neponset River; Quincy Bay; Hingham Bay into which flow the Weir, Weymouth Back and Weymouth Fore Rivers; and the Bay at Winthrop. There are approximately 180 miles of shoreline and about 30 harbor islands with a total land area of about 1200 acres.

The peninsulas of Boston, East Boston, South Boston and Charlestown all cluster around the Inner Harbor and were originally separated from the mainland by tidal marshes, which have since been filled. Originally Castle Island, Deer Island, Moon Island and Nut Island were separate islands, but they are now joined to the mainland by highway access routes and other extensive fill areas. Portions of Noddle and Breeds Islands, and all of Bird, Governor, Apple, and Hog Islands were leveled and included in Logan Airport, which alone reduced the harbor's water area by over three square miles. Appendix 1 contains a history of the development of Boston Harbor.

Climate and Meteorological Conditions

The climate of Boston falls within the zone called "humid", and as in other parts of New England, the climate is variable. It is characterized by a wide range of temperatures and frequent, but usually short periods of precipitation. Three main factors are responsible for Boston's weather. First, its latitude, 42°N, places it in the path of prevailing west to east flow of air with periodic intrusions of large bodies of air coming from the tropical and polar regions resulting in variable weather subject to rapid change. Second, the common occurrence of low air pressures assures a rather dependable supply of precipitation. Third, Boston's coastal location has a moderating effect on seasonal extremes. The area has an average temperature of 49°F, and an average precipitation of 44 inches.

Boston Harbor enjoys a temperate climate typical of its location on the easterly side of a large continent. Humidity and precipitation levels remain generally constant throughout the year. The average monthly rainfall is between three and four inches. On the average, there are 100

clear days, 106 days of partly cloudy weather, and 159 days of cloudy weather with no distinct seasonal patterns. Fog occurs on the average of two days per month. Average temperatures vary from about 25°F in January to 78°F in July.

Prevailing winds in the harbor are generally from the northwest and southwest in summer. Mean wind speeds vary from about 11.2 MPH in mid-summer to 14.5 MPH in mid-winter.

Air Quality

Boston Harbor lies within the Metropolitan Boston Air Pollution Control District, and is subject to Commonwealth of Massachusetts' regulations for the control of air pollution adopted under the provisions of Section 142D, Chapter III, General Laws as inserted by Chapter 836 of the Acts of 1969. Air pollution control legislation in Massachusetts was first enacted in 1869. However, effective legislation was not implemented until 1960, after the furor created by an exceptional soot-fall on May 13, 1960 in South Boston. Monitoring of air quality is conducted by the Commonwealth's Department of Environmental Quality Engineering's (DEQE) Division of Air Quality Control.

In the early 1960's large quantities of combustible demolition debris, principally from urban renewal efforts, was routinely reduced by open burning. In 1961 a program commenced to stop all open burning of rubbish, trash, demolition materials, scrap automobiles and scrap wire in metropolitan Boston. Most open burning had been halted by 1964. Today, open burning of scrap autos and wire, previously a common practice, has ceased. At present debris is largely disposed of by sanitary landfill or by incineration at plants in eastern Massachusetts. In 1965 the Department of Public Works prohibited brush burning in highway land clearance contracts throughout the Metropolitan District. The open burning of rubbish and brush at municipal and private dumps has also ceased.

Currently the principal pollutants of concern are ozone, nitrogen dioxide and carbon monoxide, all primarily due to vehicle exhaust. Previously the air pollutant of greatest concern in the Boston area was total suspended particulates which still substantially contribute to haze and smog.

Noise Conditions

Ambient noise levels vary greatly around the harbor. The amount of disturbance caused by a source of noise would depend on location and type of neighboring activity. All the communities around the harbor, except Cambridge and Somerville, have adopted ordinances to control noise levels. Noise sensitive land uses include residential, parks and playgrounds, schools etc. The environment in these areas is dominated by noise from motor vehicles and in some cases, air traffic from Logan Airport. In general the land abutting the deep-draft tributary channels

supports marine industrial use, and is not noise sensitive. In most cases the noise of dredging activities would not exceed the noise generated by existing industry.

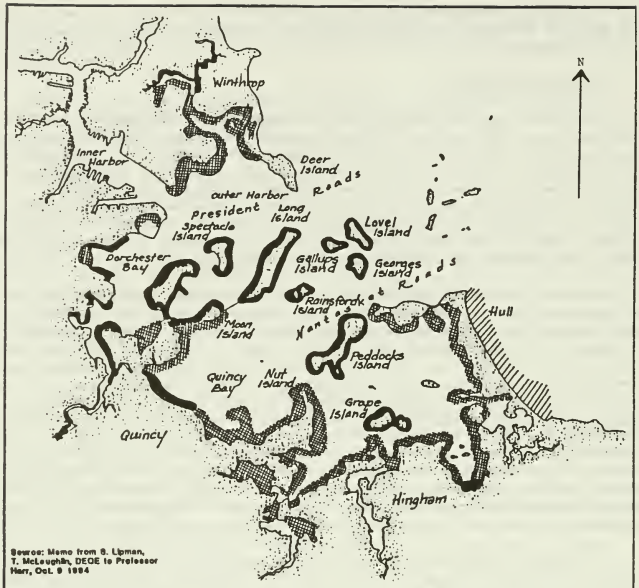
Ecological Setting

The water, marshes and terrestrial areas within the harbor provide habitats for a wide variety of birds, mammals, finfish, shellfish and other animals. Birds are the most abundant form of wildlife, especially on the islands. Existing types include common songbirds, shorebirds and migratory waterfowl as well as some uncommon species. Significant populations of small mammals, such as rabbits, squirrels, raccoons and skunks, are associated with the mainland, while rats predominate on the islands. The islands also support a great abundance of different types of insects because of the abundant cover and food supply.

Marine life within the harbor forms a significant food chain and is an important recreational and commercial resource. Many of the finfish species existing in Boston Harbor are actively fished, notably flounder and cod. Soft-shell clams, blue mussels, various crabs and lobsters are also found in the harbor. Most of the soft-shell clam sites, though, are closed to the taking of shellfish because of pollution (See Figure 4). In the remaining areas, shellfish can be harvested only by licensed master diggers, or their employees, and must undergo depuration at the Shellfish Purification Plant. No shellfish areas are open to unrestricted harvesting. Lobsters are abundant throughout the harbor and are caught in traps, or by diving for recreation, as well as for sale. Other marine animals such as bloodworms and sea worms, as well as numerous small fish, may be found along the shorelines of many islands. Harbor shellfish areas and their latest published classification are shown in Figure 4.

Freshwater flows into the harbor average 350 to 500 cubic feet per second (cfs) in the summer. Tidal input are orders of magnitude greater with flows averaging 320,000 cfs for a 6 hour period and volumes ranging from 10.6 billion gallons at low tide to 179.9 billion gallons at high tide (Metcalf and Eddy, 1976 and MDWPC, 1986). Approximately 73.3 billion gallons are exchanged through three channels linked with the President Roads area and one channel linked with Nantasket Roads. Boston regional wastewater treatment plants discharge into this system a further 500 million gallons per day of freshwater and waste outflow.

The average tidal range in Boston Harbor is 9.5 feet with spring tidal ranges often in excess of 11.0 feet. Average current velocities for the Inner Harbor are less than 0.5 knots. Velocities in other portions of the harbor are generally less than 2.0 knots, with the exception of restricted passages such as the entrance to President Roads off Deer Island Light and between Peddocks Island and Hull (Hull Gut) where the maximum predicted velocities are in excess of 2.5 knots. Maximum current velocities during spring tide at the areas to be dredged are as follows: 0.1 knots in the Mystic River, 0.2 knots in the Chelsea River and 0.7 knots in the Main Ship Channel vicinity.



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Boston Harbor and Massachusetts Bay - February 1987

BOSTON HARBOR, MASSACHUSETTS
FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT
FIGURE 4
HARBOR SHELLFISH AREAS

Water Quality

The quality of water in Boston Harbor has been the subject of considerable expenditures of Federal, State and private funds. Historically, the major contributors of water pollution in the harbor have been raw sewage discharges, combined sewage overflows (CSO's), partial waste treatment and sludge discharges, industrial discharges, urban runoff, oil spills, and poor quality of tributary streams. For the most part, the raw sewage and straight industrial discharges are being rectified to the extent that present funding and facilities will permit. The present discharge of partially treated sewage and sewage sludges and the CSO's remain the largest water quality problem in the harbor. The history of contamination is found in the harbor sediments which are discussed in further detail in the Environmental Assessment.

State and Federal agencies are cooperating on efforts to improve the water quality in Boston Harbor. The MWRA is currently designing a $2 billion secondary sewage treatment facility for the metropolitan area to be constructed on Deer Island in the 1990's. Efforts are underway by various agencies to reduced point discharges and eliminate CSO's as the new facility comes into use.

The harbor areas that are planned to be dredged are all classified as SC waters considered suitable for aesthetic enjoyment, recreational boating, industrial cooling and process use, and as habitat for indigenous wildlife and forage and game fish. The Outer Harbor areas, except for Broad Sound Channels, are classified SB waters. The classification of SB implies suitability for aesthetic enjoyment, habitat for indigenous wildlife and forage and game fish, and the harvesting of shellfish with depuration. The waters in the Broad Sound channel project are classified as SA. This classification implies excellent suitability for primary contact sports, excellent fish and wildlife habitat, and possible approval for shellfish harvesting with depuration. The assigned classifications, however, do not mean the waters meet the criteria because of the CSO's.

Water quality in Boston Harbor has been found to vary both spatially and temporally. The data contained in Table 2 is in general a seasonal summary of previously available data. A more recent data set for June through October 1985 (MDWPC, 1986) is also within the ranges listed on this summary table.

Salinity data indicate the Outer Harbor is being well mixed, while the various regions of the Inner Harbor are very definitely under the influence of freshwater inputs. Essentially, the mouth of the harbor is considered stenohaline and the Inner and Outer Harbor areas are euryhaline. Oil pollution has created problems in many harbor areas and a permanent oil boom is maintained at the mouth of Chelsea Creek to protect the remainder of the harbor from potential spills in the main tanker terminal area.

TABLE 2

WATER QUALITY IN BOSTON HARBOR

Physical Parameters[2]	Inner Harbor	Outer Harbor	Outside Harbor
Temperature °C	0-21	0-22	0-25
Salinity, ppt	4-32	21-34	28-34
Chemical[2]			
D.O., ppm	2.41-11.49	6.02-14.0	6.48-12.65
Nitrogen, mg/l			
Ammonia - N	0.01-1.0	0.01-1.02	0.01-0.40
Nitrate - N	.002-1.24	.001-.570	.002-940
Phosphorus, mg/l			
Total	0.05-1.02	.024-1.33	.010-.133
Ortho	.007-.924	.010-1.17	.018-.082
Zinc[3] ppb	30.6-62.2	7.8-16.7	--
Copper[3] ppb	2.8-6.6	1.9-8.6	--
Lead[3] ppb	2.2-10.6	1.2-2.7	--
Nickel[3] ppb	7.2-13.6	0.1-13.6	--
Chromium[3] ppb	0.2-3.69	0.1-1.2	--
Cadmium[3] ppb	0.34-0.56	0.11-1.10	--
Biological[2]			
Bacterial cts.			
(coliform)	0-96,000	0-10,000	0-4,200

(1) Table from Jason Cortell Associates (1977)
(2) New England Aquarium (1973)
(3) New England Aquarium (1972) (values are for soluble phase)

The bacterial quality of the harbor waters have been extensively investigated. There are many areas in the Inner and Outer harbors which are considered grossly contaminated; and, regardless of the water classifications, the harvesting of shellfish is prohibited. The general densities of total coliform bacteria are indicated in Table 2 and MDWPC, 1986. The inputs of bacteria are principally attributable to the CSO's (combined sewer overflow) and those bacteria surviving treatment plant chlorination. High levels of bacteria have been found in the rivers which drain into the harbor, but the sources have never been documented. It is not unusual for the swimming beaches to be closed following a storm of moderate duration and intensity due to bacterial contamination from the CSO's.

Boston Harbor is one of the few areas along the Massachusetts coastline which furnishes good sport fishing year-round. The species fished include winter flounder, Atlantic mackerel, striped bass, rainbow smelt, Atlantic cod, pollock, and red hake. Sport fishermen can board party and charter boats and usually catch haddock, cod, flounder, mackerel, pollock, cusk and eel.

There are approximately 1200 acres of salt marsh remaining within the harbor. These areas are ecologically important because they contain suitable habitat for wildlife; function as nurseries for marine organisms, especially finfish; and are significant sources of vegetative biomass to the food chain of the harbor estuary.

Harbor Use

Boston Harbor, an urban estuarine environment, is extensively utilized for fishing, transportation, recreation, shipping, and commercial and industrial activities. A high level of water pollution existing in the Inner Harbor, restricts the area's use to recreational boating, fishing and industrial activities. The Outer Harbor is suitable for swimming, fishing, boating and shellfishing with depuration. The major sources of water pollution in the harbor include combined sewer overflows, debris and refuse, wastewater treatment discharges, tributary streams, ship and pleasure boat discharges and stormwater runoff. The immediate harbor area is shown in Figure 3.

Dorchester Bay and the Inner Harbor are influenced by the dense development of the city of Boston. Commercial development along the Dorchester Bay and the Inner Harbor has substantially altered the natural environment once present. Despite such commercial and industrial development along harbor waters, a surprising proportion of the harbor remains undeveloped. However, these areas are rapidly diminishing. Many of the islands along the shoreline have been used for prisons, hospitals, sewage treatment facilities, landfill and military sites. Recently the Boston Harbor Island State Park was designated by the state legislature, including virtually most of the harbor islands. The landscape and vegetation of the harbor area, including the islands, have been

extensively altered by man. The predominant characteristic of the upland vegetation in natural areas is thick impenetrable brush, while some areas are composed of a variety of trees and shrubs.

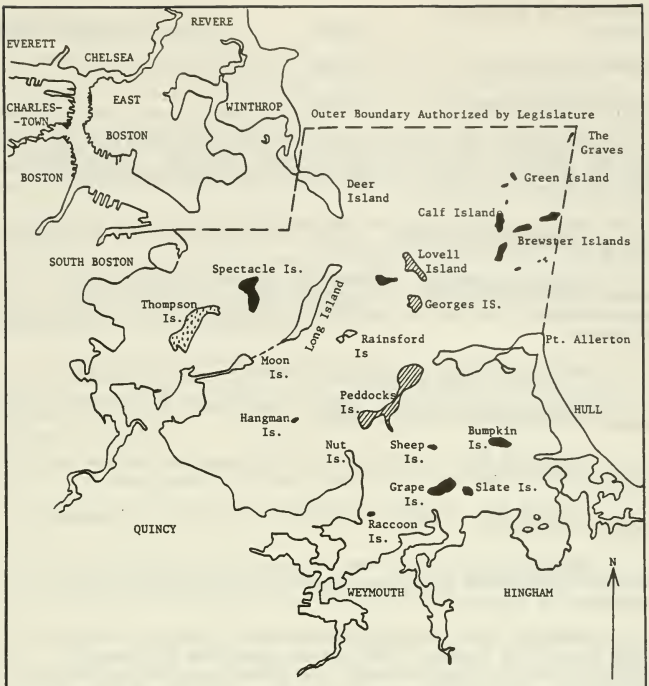
The Metropolitan Area Planning Council (MAPC) and the city of Boston are both very active in preparing plans for recreational development and conservation of land along the waterfront. The major emphasis of the waterfront plans of these agencies is towards those uses which provide for public enjoyment of the harbor and the preservation of its ecological resources.

In 1976 MAPC published the Boston Harbor Islands Comprehensive Plan,[1] under which it is proposed to protect all the harbor islands from undesirable uses and to either develop their potential as historical sites and recreation areas, or to leave them undeveloped as conservation areas. In response to the plan, the Boston Harbor Islands State Park was created by the legislature in cooperation with the city of Boston and surrounding communities in response to the plan. The plan also envisages turning much of the Outer Harbor waterfront into conservation areas. The authorized park boundaries and islands acquired to date are shown in Figure 5.

The Comprehensive Plan envisages the development of harbor islands to provide the following annual recreational opportunities:

Group Camping	34,000	Recreation	Person	- Days
Family Camping	6,000	"	"	"
Primitive Camping	1,200	"	"	"
Fishing	54,000	"	"	"
Play	220,000	"	"	"
Historic Fort Visitations	305,000	"	"	"
Swimming	335,000	"	"	"
Picnicking	203,600	"	"	"
Boating	111,000	"	"	"
Hiking, Nature Walks, etc.	222,850	"	"	"

[1] Boston Harbor Islands Comprehensive Plan, prepared for Massachusetts Department of Natural Resources by the Metropolitan Area Planning Council, October 1972.



BOSTON HARBOR, MASSACHUSETTS

FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT

FIGURE 5

BOSTON HARBOR ISLANDS
STATE PARK

Conference and Recreation Center	130,000	Recreation	Person -	Days
Model Farm Visitation	70,000	"	"	"
Fish Hatchery Visitation	10,000	"	"	"

In addition to the Harbor Islands Plan, MAPC also published the 1976 Regional Open Space Plan in July 1976. Under this plan, it is proposed that the following recreational and conservation areas be developed or improved along the harborfront.

- Chelsea Naval Hospital. A 20-acre waterfront park is recommended for the southwestern part of the site.

- Downtown Waterfront. Linking the waterfront park between Commercial and Long Wharves to Government Center by a traffic free pedestrian mall. This can be realized if the central artery is depressed as proposed.

- Belle Isle Marsh, East Boston - Protection (for Wildlife)

- Constitution Beach, East Boston - Improvement of water quality to protect the beach.

- Dorchester Bay - Public control of the coastline and the design of a Dorchester Bay Reservation from South Boston to Tenean Beach.

- Mainside Park, Hingham - Development of the park as proposed by the town of Hingham.

- Nantasket Beach, Hull - That the open space/recreational value of the beach by protected from incompatible nearby development and that maintenance be improved.

In September 1976, the Boston Redevelopment Authority produced the Boston Urban Wilds Program.[1] This program identifies 573 acres of shoreline property along the harbor to be either developed as parkland or protected as a conservation area. In addition, the city of Boston[2] is acquiring a 11-acre site to develop a waterfront park at the corner of Summer and New Streets in East Boston. The city is also planning a small park where the Charlestown Bridge abuts Charlestown, an extension of the existing North End Park towards Charlestown Bridge and a small park on Fort Point Channel in front of the relocated Children's and Transportation Museums. A large waterfront park is currently under construction on the Little Mystic Channel in Charlestown.

[1] Boston Urban Wilds - A Natural Conservation Program - Boston Redevelopment Authority, September 1976.
[2] Oral Communication from the City of Boston, Conservation Commission.

Human Resources

Dense urban concentrations of population surround the Inner Harbor with the cities of Boston, Cambridge, Somerville, Everett, and Chelsea forming the inner core of the metropolitan Boston area. Population densities vary inversely with distance from the metropolitan core, with the exception of the towns of Winthrop and Hull at the extremities of the bay. These towns, with very limited areas and considerable waterfront, have experienced a high degree of development. Table 3 describes the population characteristics of the immediate Boston Harbor communities.

The period from 1960 to 1980 was an era characterized by outmigration of population from the metropolitan Boston area. The population of the city of Boston declined approximately 8 percent between 1960 and 1970 and approximately 12 percent between 1970 and 1980. Similar declines were experienced for the entire inner metropolitan area in this period. State census figures for 1985, updated in 1987, show a continuing loss of population to outlying communities.

Per capita income (1982 dollars) increased in the metropolitan area with the exception of the city of Everett, which declined approximately 2 percent between 1974 and 1979. Per capita income increases were highest in the city of Boston. Per capita income for the Boston Metropolitan Area is shown in Table 4.

TABLE 3

POPULATION TRENDS
BOSTON METROPOLITAN AREA

Place	1980	1970	1960
Boston	562,994	641,071	697,197
Cambridge	95,322	100,361	107,716
Somerville	77,372	88,779	94,697
Everett	37,195	42,485	43,544
Chelsea	25,431	30,625	33,749
TOTAL	798,314	903,321	976,903

TABLE 4

PER CAPITA INCOME
BOSTON METROPOLITAN AREA
(1982 DOLLARS)

City	1974	1979	% Change
Boston	$7,698	8,340	8.3
Cambridge	9,774	10,123	3.6
Everett	8,313	8,295	0.2
Lynn	8,192	8,253	0.7
Quincy	9,365	9,701	3.6
Revere	8,319	8,473	1.9
Somerville	7,922	8,078	2.0

For nearly 350 years, the Port of Boston has been the gateway to international trade opportunities for much of New England's business community. During the early stages of the Industrial Revolution, water was both a prime source of power for industry and the primary means of transport. With the advent of the steam engine and railroads, dependence on water was lessened, but transport by sea still remained cheaper than by land. An ocean port such as Boston is the interface between land and sea, and also the point of arrival of merchandise from foreign lands. The port's waterfront was not only the point for transfer from ocean to inland transport, but the point at which goods had to be inspected and customs duties assessed. It was the logical point to store and distribute imports as well as to locate industries dependent on seaborne materials. There were also a large number of sea related activities, such as ship building, ship repairs, and provisioning. Prior to the development of air transport, ports handled all transoceanic passenger traffic. This resulted in a high demand for waterfront land and its intense development for port, commercial, and industrial activities.

The picture has now changed largely due to modern means of transporting and handling goods. The introduction of containers as an important means of transporting general merchandise coupled with the inland transport under customs bond (i.e. sealed) has made it convenient to locate the point of customs clearance and distribution inland. Ship building has declined dramatically in the United States and is concentrated in a few highly mechanized shipyards. Ship repairing has gravitated to countries with low labor costs and many repairs are carried out at sea while the ship is in operation. The former General Dynamics Yards on the Fore River in Quincy has been closed for several months. Most recently the Mass. Water Resources Authority has sought to purchase the 181 acre shipyard, ending negotiations by a coalition of Shipyard workers to purchase and reopen the facility. The MWRA plans to use the site for a staging area for construction equipment and materials in conjunction with construction of the new Deer Island Treatment Plant.

The most dramatic shift in waterfront usage has come about from modern methods of transport, such as container transport, roll on/roll off ships and LASH barges. Boston Harbor has experienced a rapid increase in container traffic, largely as a result of Massport's investment in terminal facilities. To insure that the region and its port continue to prosper and grow, Massport remains committed to maintaining a strong maritime operation in the Port of Boston. Methods of handling waterborne port trade have drastically shifted the resource requirements from operations heavily dependent upon labor to one of heavy capital investments. These cargo handling procedures have drastically shortened the time to load and unload ships. Due to the heavy capital investments in ships and dock equipment, it is imperative that ships be turned around in minimum time to be profitable. A large container ship can be turned around in eight hours, whereas, an equivalent breakbulk (non-containerized general cargo) ship would require 36 hours, or 4 to 5 eight hour working days. Any vessel not vacating its berth on completion of its operations is subject to a heavy charge at the Moran Container Terminal. The size of

ships has also increased. Although the number of vessels arriving in the harbor has steadily decreased, tonnage handled has increased, resulting in a decrease in the number of facilities, berths and piers needed to handle port traffic has also decreased. Further, modern handling methods require entirely different layouts, entailing major reconstruction. Old wharves are abandoned and often replaced by new ones at other locations.

Containerization has become a vital sector of international waterborne commerce and competition between the country's ports has forced the terminal industry to adopt this modern handling method. In addition to its cost efficiency, containerization has greatly reduced the degree of pilferage and damage to cargo. With the rapidly increasing containerized trade, the port must service the incoming containerships efficiently to maintain its port trade.

The Port of Boston offers shippers a wide variety of privately operated commercial marine services. These services include skilled pilots, skilled ship repair and refitting facilities, experienced tug captains and linehandlers, and complete seamens and immigration services. The U.S. Coast Guard, with it's base on the Charles River Channel along the North End Waterfront, provides harbor security and pollution monitoring and maintains an extensive system of navigation aids. All of these services enable the port to handle more than 25 million tons of cargo, 2 million of which were exports generated by the New England region. New England generated cargo carried an average value of $3,600 per ton, giving the Port of Boston's exports the highest unit value for cargo in the United States. The region has a prosperous economy, with serveral states having the lowest unemployment rates in the nation, less than four percent.

As other service industries expand many former marine-industrial piers and wharves have been converted to residential-office-retail use. In 1970 Congress declared a portion of the Boston waterfront from the Fort Point Channel to the Charles River to be nonnavigable in response to the extreme state of decay and dilapidation of the piers and facilities. This action paved the way institutionally for revitalization, which has resulted in rehabilitation of these piers for residential and office buildings, museums, hotels, marinas, etc. This area of the city now boasts some of the highest real estate values in the New England Region. Only the U.S. Coast Guard Base on the North End's Charles River waterfront remains in use for deep-draft craft.

A similar transformation is taking place along the Charlestown Waterfront below Massport's Mystic Piers facility. In this, the former Charlestown Naval Base and Railyard Terminal Piers are being converted into a Historic Park, marinas, office space and residential condominiums.

The development of the Fan Piers parcel in South Boston at the junction of the Fort Point and Main Ship Channels is currently proposed along similar lines. A $1 billion plus development plan involving hotels, convention centers, retail and office space as well as residential and

marina use are proposed in this. As a result, cities surrounding the Inner Harbor will have enhanced their opportunity for redevelopment as attractive waterfront sites with more potential for residential and commercial use. Increased values of residential property with an attractive waterfront has already been well demonstrated.

The city of Boston has recognized the opportunities for realizing dividends from redevelopment of its waterfront areas and is currently implementing this redevelopment. The North End Waterfront between Lewis Wharf and the entrance to the Fort Point Channel has been mostly redeveloped. Warehouses on Lewis, Commercial, and Long Wharves have been converted into attractive offices, shops, restaurants, hotels and condominiums by private developers with city assistance. The New England Aquarium, a highly visible tourist location together with high rise apartments already converted to condominiums, now grace the waterfront. The city of Boston has invested millions in improving its streets, sidewalks, sewers, and lighting, as well as establishing a waterfront park. The concept of a relatively continuous public promenade along the harbor waterfront is steadily becoming a reality as Harbor Park. Under city regulations new waterfront development must include public access to the shoreline. A park has been placed between Long and Commercial Wharves giving central Boston access to the waterfront, and plans for the reconstruction of Long Wharf for public harbor access are nearing completion.

Meanwhile, the Metropolitan Boston area has been experiencing a dramatic shift in the labor market demands as a result of the employment developments within the major manufacturing and service sectors. Over the past 25 years there has been a decrease in employment of 62 percent in the manufacturing sector while employment in the services sector has grown by 80 percent. The average annual nonagricultural wage and salary employment in the Boston-Lawrence-Salem-Lowell-Brockton/New England County Metropolitan Area (NECMA) during 1983 was 2,064,900 jobs. This increase of 338,800 jobs over the 1969 annual average represents an annual growth rate of approximately 1.3 percent. During this period, employment in the nonmanufacturing sector grew by 331,700 jobs accounting for 98 percent of the total employment gains. The manufacturing sector recorded an increase of 7,100 jobs over this period.

The major industries in terms of employment in the Metropolitan Boston area consist of the electronics, machinery, instruments, transportation equipment, fabricated metals, and printing industries within the manufacturing sector. The wholesale and retail trades, services, and government employ the largest numbers of workers within the nonmanufacturing sector. Table 5 illustrates the historical and projected population, employment, personal income, and earnings within the Boston area.

TABLE 5

POPULATION, PERSONAL INCOME, AND EARNINGS

Boston-Lawrence-Salem-Lowell-Brockton, MA (NECMA)
1969-1983 and Projected, 1990-2035

	1969	1983	1995	2035
Population as of July 1 (Thousands)	3,682.8	3,673.4	4,141.3	4,990.00
Total personal income (place of residence)	17,800.3	24,586.3	34,869.8	60,336.7
Total earnings (By place of work)	14,442.2	19,124.0	28,769.3	47,659.7
Farm	30.9	29.7	26.5	30.9
Nonfarm	14,411.3	19,094.3	28,742.8	47,628.7
Private	12,417.8	16,619.4	25,747.9	43,372.5
Construction	914.2	783.3	1,208.1	1,881.3
Manufacturing	3,825.5	4,901.1	8,158.3	15,309.9
Nondurable goods	1,478.7	1,198.9	1,478.1	2,014.1
Durable goods	2,346.8	3,702.2	6,680.2	13,295.8
Transportation and public utilties	898.5	1,258.1	1,992.8	3,462.8
Wholesale trade	1,044.2	1,313.4	1,846.5	2,930.6
Retail trade	1,577.8	1,693.1	2,224.7	3,414.8
Finance, insurance, and real estate	1,035.6	--	2,337.6	3,655.3
Services	3,075.4	5,108.2	7,860.0	12,531.7
Government and government enterprise	1,993.6	2,474.9	2,994.9	4,256.3

EMPLOYMENT BY PLACE OF WORK, BY INDUSTRY

Boston-Lawrence-Salem-Lowell-Brockton, MA (NECMA)
1969-1983 and Projected, 1990-2035

	1969	1983	1995	2035
Total employment (in Thousand of Jobs)	1,726.1	2,064.9	2,638.7	2,908.3
Farm	6.3	5.4	5.0	4.3
Nonfarm	1,719.8	2,059.6	2,633.7	2,904.0
Private	1,470.3	1,781.2	2,346.2	2,632.6
Construction	84.2	74.6	102.1	112.6
Manufacturing	403.5	410.6	546.6	635.0
Nondurable goods	178.2	121.8	123.8	105.2
Durable goods	225.3	288.8	422.9	529.8
Transportation and public utilties	87.2	92.0	116.5	132.9
Wholesale trade	98.9	115.2	139.2	158.1
Retail trade	283.2	330.6	412.7	450.4
Finance, insurance, and real estate	104.4	--	191.0	218.3
Services	401.8	605.3	820.7	902.3
Government and government enterprise	249.5	278.3	287.5	271.4

Source: OBERS

In July 1986, 50,520 of the total resident labor force of 1,550,060 were unemployed. This unemployment rate of 3.3 percent compared with the rate of 3.8 percent for Massachusetts, was 0.5 percentage points less than the July 1985 average of 4.3 percent.[1]

Development and Economy

The port and industrial facilities within the harbor are located primarily along the shorefronts of the city of Boston and the neighboring communities of Everett, Chelsea and Revere. There are approximately 200 piers, wharfs, docks, deep draft berths, repair facilities, marinas and terminals located within the port of Boston, 80 percent of these facilities are located within the limits of the Inner Harbor. The remaining 20 percent of these facilities are located along the waterfront within the communities of Winthrop, East Boston, Dorchester, Quincy, Weymouth, Braintree, Hingham and Hull. Table 6 summarizes the number and location of these facilities.

With the modernization of cargo handling methods and the increasing size of vessels entering the harbor there has been abandonment of some waterfront sites engaged in cargo handling operations. These piers have been allowed to deteriorate and are being converted to other commercial or non-commercial uses.

The Boston area is well known for its universities, colleges, and medical facilities. It is the home of institutions of learning of the highest international standing, with a very high number of colleges. These institutions have spawned a large number of research firms, firms manufacturing advanced technical equipment, and specialized consultant firms of national and international repute. This is reflected in Table 5 where earnings from services, which includes university staff and consultants, are projected as 26.7 percent of total earnings in 1983, as compared to the national average of 12.0 percent.

Boston Harbor is not the site, and is unlikely to become the site, of heavy industries such as steel, petroleum refinery, and petrochemicals which favor locations with direct access to port facilities.

When it is considered that other traditional New England labor intensive industries such as textiles have also declined, it can be seen that Greater Boston's continued prosperity depends greatly on attracting firms in advanced technology who wish to tap the pool of highly skilled professionals available in the area. Professional manpower is highly mobile and will prefer to locate in an area where they can find social, cultural, and recreational opportunities to suit their taste.

[1] DES Employment Review, July 1986.

TABLE 6

BOSTON HARBOR, MASSACHUSETTS

PORT AND HARBOR FACILITIES

Location	Number of Waterfront Piers and Facilities
1 Deer Island:	3
2 Winthrop:	
Winthrop Head	1
Winthrop Harbor	2
East Boston Harbor	1
3 East Boston:	
Belle Isle Inlet	1
East Boston Harbor	1
4 East Boston:	
Main Ship Channel	23
Chelsea River	7
5 Revere:	
Chelsea River	3
6 Chelsea:	
Chelsea River	15
Head of Main Ship Channel	3
Island End River	1
Mystic River	1
7 Everett:	
Island End River	3
Mystic River	7
8 Malden:	
Malden River	1
9 Medford:	
Malden River	2
Mystic River	1
10 Somerville:	
Mystic River	3
11 Charlestown:	
Mystic River Chennel	7
Little Mystic Channel	1
Main Ship Channel	7
Charlee River (Below Dam)	5
12 Boston:	
Charles River (Below Dam)	3
Main Ship Channel	18
13 South Boston:	
Fort Point Channel	4
Main Ship Channel	10
Reserved Channel	15
Main Ship Channel	2
Old Harbor	2
14 Dorchester:	
Neponset River and Port Norfolk	5
Malibu Cove	1
Savin Hill Cove	2
Columbia Point	(1 Proposed)
15 Quincy:	
Neponset River	2
Town River	8
Weymouth Fore River	5
Hollaston	2
Squantum	1
16 Braintree:	
Weymouth Fore River	3
17 Weymouth:	
Weymouth Fore River	2
18 Eastern Neck and Hingham:	
Weymouth Back River	2
19 Hingham Harbor:	3
20 Hull:	
Nantasket (Weir River)	1
Hull Bay	2
Allerton Harbor	3
Pemberton Harbor	1
21 Harbor Islands:	
Little Brewster	1
Fort Warren	1
Gallops Island	1
Thompson Island	1
Spectacle Island	1
Long Island	2

TOTAL FOR INNER AND OUTER HARBORS 204

From: 1983 Port Series, updated from aerial surveys of 1985 & 1987

Boston, with its many local and regional historical associations, is a major tourist center, that continues to support the urban renewal presently underway. A center for history, culture, natural beauty and activities of every type, it is quickly becoming a stopover for cruise ship lines.

In terms of waterborne commerce, Boston Harbor is the largest port in New England. In 1986, total waterborne commerce for the port, as reported by Massport, was 25,944,092 short tons valued at over $7 billion. Estimates for 1987 tonnage exceed 18 million tons of cargo. Of the total volume of waterborne commerce in 1986, approximately 91 percent were liquid petroleum products and the remaining 9 percent was non-petroleum bulk, containerized and neo-bulk cargo. A comparitive statement of cargo volumes for the port is detailed in Table 7.

TABLE 7

BOSTON HARBOR
COMPARATIVE STATEMENT OF TRAFFIC

Year	Bulk (Tons)	Passengers	Year	Bulk (Tons)	Passengers
1967	21,549,086	264,358	1977	25,975,275	724,477
1968	22,610,760	213,565	1978	26,073,590	238,499
1969	24,818,746	314,115	1979	26,342,672	260,464
1970	26,867,918	76,730	1980	22,033,922	113,235
1971	26,156,517	304,718	1981	20,306,450	365,117
1972	26,483,438	143,635	1982	17,593,627	393,483
1973	27,056,868	407,134	1983	17,036,478	49,420
1974	25,728,845	476,353	1984	19,888,675	395,131
1975	24,719,452	546,803	1985	17,268,816	358,678
1976	26,172,442	724,477	1986	21,035,972	----

Source: Waterborne Commerce of the United States DA,COE

The majority of the waterborne cargo handled in the Port of Boston is comprised of foreign freight traffic, accounting for 52.7 percent of the total tonnage moved in 1986, with imports accounting for over 95 percent of this tonnage. Coastwise freight traffic accounted for 43.8 percent of port's the total tonnage with the remaining 3.5 percent due to internal and local freight traffic. Of the domestic coastwise receipts in that

year, 91.3 percent of this tonnage consisted of petroleum products transported from refineries on the East Coast and the Gulf Coast. Table 8 shows the breakdown of waterborne traffic movements within Boston Harbor from Waterborne Commerce of the United States 1986.

TABLE 8

BOSTON HARBOR
WATERBORNE TRAFFIC MOVEMEMENT, 1986

Foreign		Domestic	
Imports	50.3%	Coastwide Receipts	38.6%
Exports	2.4%	Coastwide Shipments	5.2%
		Internal Receipts	<0.2%
		Local	3.3%

The tonnage of Boston's foreign trade for the period 1972-1986 is shown in Table 9. The foreign trade in the port fluctuated widely throughout this period, decreasing markedly during 1975, 1980 and 1982. Figures for years immediately following the downturn, however, show an increase toward the previous year's level.

Imports constitute a large percentage of the foreign trade handled in Boston Harbor. Table 10 lists the major commodities imported and exported through Boston. Of the petroleum products imported into Boston Harbor, about 36.0 percent is distilled fuel oil, 37.7 percent is residual fuel oil and 24.2 percent is gasoline. Imports of LNG, which had been suspended for the past two years, were resumed in January 1988. The imported petroleum products represent about 51.0 percent of the total petroleum products tonnage moved through the port.

TABLE 9

BOSTON HARBOR
FOREIGN TRADE TONNAGE
1972 - 1986

Year	TONNAGE			PERCENT CHANGE		
	Exports	Imports	Total	Exports	Imports	Total
1972	757,707	7,872,977	8,630,684			
1973	816,240	10,189,201	11,005,441	8	29	28
1974	881,339	8,397,307	9,386,340	8	-18	-15
1975	546,962	5,987,864	6,534,456	-38	-29	-30
1976	534,599	7,133,685	7,668,287	-2	19	17
1977	501,847	7,547,246	8,049,093	-6	6	5
1978	794,267	6,712,290	7,506,557	58	-11	-7
1979	852,353	7,302,197	8,154,550	7	9	9
1980	835,615	5,192,062	6,027,677	-2	-29	-26
1981	578,641	6,778,460	7,357,101	-31	31	22
1982	497,916	4,740,215	5,238,131	-14	-30	-29
1983	623,046	5,397,293	6,020,339	25	14	15
1984	876,659	7,655,355	8,532,014	41	42	42
1985	757,165	6,851,540	7,608,705	-14	-11	-11
1986	503,141	10,585,681	11,088,822	-34	+55	+46

Source: Waterborne Commerce of the Unites States, ACE

TABLE 10

BOSTON HARBOR
LEADING IMPORTED AND EXPORTED COMMODITIES

Leading Commodities Imported into Boston - 1985 and 1986
(Foreign)

	Short Tons	
	1985	1986
Petroleum Products	5,172,149	9,451,296
Building Cement	140,263	266,512
Sugar	184,908	155,270
Gypsum	181,847	118,358
Motor Vehicles, Parts, Equip.	104,753	114,066
Alcoholic Beverages	74,891	95,070
Vegetable Oil, Margarine, Shortening	1,150	43,995
Fresh Fish	47,802	42,443
Salt	49,433	42,170
Machinery, Except Electrical	18,796	21,506
Chemicals and Chemical Products	17,476	15,882
Structural Clay Products	14,647	12,639
Fabricated Metal Products	13,973	11,766
Paper and Paperboard	5,298	11,301
Cut Stone and Stone Products	3,407	11,130
Furniture and Fixtures	11,613	10,662
Lumber	24,409	6,467
Prepared Fruit and Vegetable Juice	7,980	10,411
Newsprint Paper	60,914	253
Liquefied Gases	554,068	76
Benzene and Toluene	17,498	--
Sand, Gravel and Crushed Rock	10,748	168

Leading Commodities Exported from Boston - 1985 and 1986
(Foreign)

	Short Tons	
	1985	1986
Ferrous Scrap	676,663	426,067
Paper Waste and Scrap	21,889	17,890
Paper & Paperboard	6,919	7,208
Chemicals and Products	5,986	5,121
Animal Byproducts	4,424	4,387
Fresh Fruits	1,513	3,534
Plastic Materials	2,401	3,480
Nonferrous metal scrap	5,680	3,295
Instruments (time, photo, optical goods)	4,092	3,068
Machinery, except elect.	3,443	2,775
Electrical Machinery and Equipment	2,150	2,462
Newsprint Paper	42	2,145
Lumber	1,214	1,949
Fabricated Metal Products	1,625	1,907
Textile Waste, Scrap, Sweep	1,421	1,688
Basic Textile Products	1,258	1,499
Rubber and Misc. Plastic Products	692	1,239
Leather and Leather Products	1,079	974
Pulp and Paper Products	1,161	728
Liquified Gasses	1,413	656
Dried Milk and Cream	1,774	--

Source: Waterborne Commerce of the United States, ACE, 1985 and 1986

The arrival of vessels having drafts greater than 18 feet are detailed in Table 11. The total number of unassisted self-propelled vessel arrivals for 1979 having drafts greater than 18 feet represent approximately 16 percent of the total vessel arrivals recorded.

TABLE 11

VESSEL ACTIVITY IN THE PORT OF BOSTON
DRAFTS >18 FEET

ARRIVALS

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1985	1986	1987
Bulk Carriers	225	235	132	129	120	126	134	118	118	106	92	77	82	81
Break Bulk, General Cargo	480	401	196	140	160	137	141	117	134	119	107	91	85	89
Fully Containerized General Cargo	163	244	276	272	279	262	265	284	289	291	277	200	215	248
Passenger	36	53	24	19	9	8	8	14	25	28	21	14	19	23
Tankers/LNG	635	665	633	571	583	628	542	548	440	427	337	323	374	315
Other	10	31	19	32	24	29	38	38	27	30	27	14	7	11
TOTAL	1,549	1,629	1,280	1,171	1,175	1,190	1,178	1,119	1,033	1,001	861	719	782	767
Container Feeder Barges													192	184
													974	951

Source: Massport

Of the deep draft vessels (characterized as having drafts greater than 30 feet) that arrived in the port, approximaely 63 percent went to the main waterfront (including the Reserved Channel), 25 percent to the facilities on the Chelsea River, and 12 percent to the Mystic River. Table 12 displays the frequency of vessel use of Boston Harbor by range of vessel draft for drafts greater than 20 feet. The total number of recorded commercial vessel trips through the Port of Boston in 1985 was 13,829 of which 1,623 were by vessels drafting at least 20 feet.

Ships drafting greater than 32 feet must ride the tide to gain access to the harbor due to the depth limitations in interior channels. Vessels drafting greater than 35 feet are also limited to tidal navigation through the 40-foot entrance channel. Underkeel allowances of 3 feet in the Inner Harbor and 5 feet in the entrance channel are normally required by docking pilots and harbor pilots, respectively for larger vessels. A draft of 39.5 feet is the present maximum limitation due to the average lowest high water level of +7.8 feet in the inner harbor and allowing for transit times to berths and 3 feet underkeel in a 35-foot channel (35+7.8-3=39.8). Due to these inner harbor limitations and the opportunity for tidal navigation, significant excess draft capacity exists in the 40-foot entrance channel.

TABLE 12

TRIPS AND DRAFTS OF VESSELS USING BOSTON HARBOR
(1960-1985)

DRAFT (FT.)	1960	1965	1970	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
41-45	--	3	1	3	--	--	--	--	--	--	--	--	--	--
36-40	24	53	214	195	218	226	206	219	127	122	76	77	131	113
31-35	438	440	477	368	396	427	371	370	311	314	292	264	210	209
26-30	669	500	483	598	649	667	590	675	638	705	677	539	455	453
20-25	2,135	2,074	1,622	1,051	1,028	826	704	743	667	669	711	710	852	848
TOTAL	3,266	3,067	2,799	2,213	2,294	2,146	1,871	2,007	1,743	1,810	1,756	1,590	1,648	1,623

Source: Waterborn Commerce Statistics ACE

There are seven deep-draft general cargo marine terminals in the Port of Boston with berthing capacity to accommodate up to 30 ships.

The Boston - Mystic Public Container Terminal located at the J. F. Moran Docks in Charlestown (Massport) is a 44-acre facility capable of loading and unloading the largest containerships.

The Conley Terminal (Massport) or Castle Island Terminal, Commonwealth Pier, the Boston Army Base Pier II, and the Harbor Gateway Terminal (Massport) all located in South Boston, provide 35 to 40-foot depths at MLW for docking vessels.

The Mystic Pier (Massport), located in Charlestown on the Main Ship Channel, has the capacity for four deepwater vessels for container or bulk cargo operations.

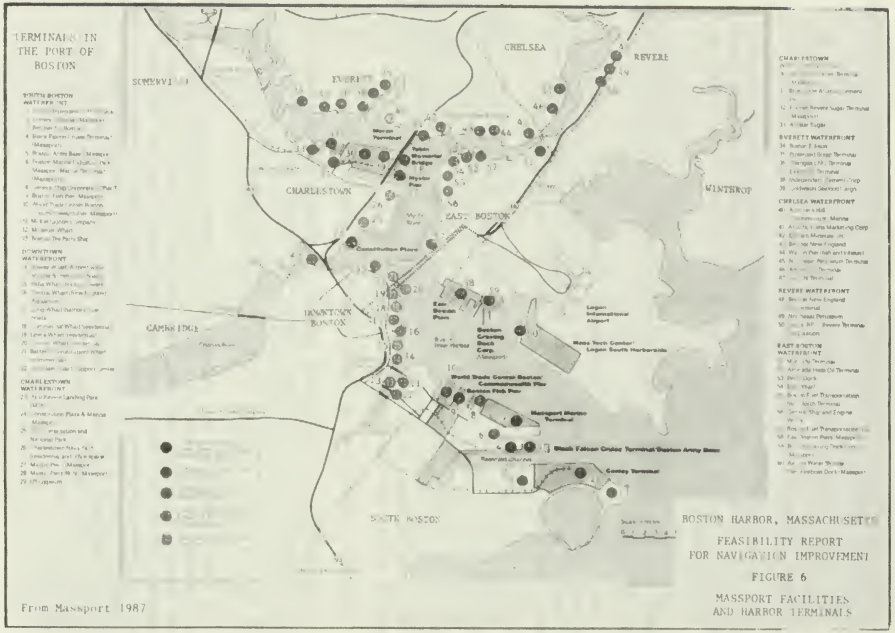
Pier 1 (Massport) of the East Boston Terminal complex is of recent construction with the potential to be a focal point in the development of the new Port of Boston. The adjacent vacant and dilapidated piers were recently purchased by Massport and are about to undergo renovation.

Massport is currently renovating the former Revere Sugar terminal on the Mystic River. For the next decade or more this facility will be used by the Water Resources Authority for staging for construction activities for the new Deer Island Treatment Plant and Harbor Cleanup operation. Construction equipment, materials and workers will be transported to the island by barge and ferry service. When the plant is completed, estimated now for 1999, Massport will convert the facility to a mix of uses including office space and general cargo use.

Massport's properties on Boston Harbor are shown in Figure 6.

In addition to the deep-draft general cargo handling terminals, 12 facilities handle petroleum liquid bulk, three handle dry bulk, one handles scrap metal and one facility located in Charlestown operates a sugar refinery. A summary of the piers, wharves and docks by purpose of which used or service offered is detailed in the Table 13.

In terms of tonnage, the second largest commodity imported into the Port of Boston in 1985 was liquified gas. A total of 554,068 short tons of LPG (propane) and LNG (methane) were received in that year. Shipments of gasses, for the most part were suspended during 1986 and 1987 with monthly shipments resuming in January 1988. The Exxon Company, U.S.A. and Distrigas of Everett, and the Boston Gas Company in Dorchester have facilities equipped to receive liquified gas shipments. However, the Boston Gas Company facility located on the 18-foot Dorchester Bay Channel is restricted by channel depth and has not received an LNG shipment in recent years.


TERMINALS IN THE PORT OF BOSTON
SOUTH BOSTON WATERFRONT
DOWNTOWN WATERFRONT
CHARLESTOWN WATERFRONT
SOMERVILLE
EVERETT
CHELSEA
REVERE
WINTHROP
CHARLESTOWN
EAST BOSTON
DOWNTOWN BOSTON
CAMBRIDGE
SOUTH BOSTON
Mystic River
Tobin Memorial Bridge
Mystic Pier
Constitution Pieers
Logan International Airport
Boston Edison Pier
Boston Crossing Stock Corp. Massport
Moss Tech Corridor/ Logan South Harborside
World Trade Center Boston/ Commonwealth Pier
Boston Fish Pier
Massport Marine Terminal
Black Falcon Cruise Terminal/Boston Army Base
Conley Terminal
CHARLESTOWN
EVERETT WATERFRONT
CHELSEA WATERFRONT
REVERE WATERFRONT
EAST BOSTON WATERFRONT
BOSTON HARBOR, MASSACHUSETTS
FEASIBILITY REPORT
FOR NAVIGATION IMPROVEMENT
FIGURE 6
MASSPORT FACILITIES
AND HARBOR TERMINALS
From Massport 1987

The ship building and repair industry in Boston Harbor is another facet of the port's commercial activity. The largest ship repair and conversion plant in New England is the General Ship and Engine Works in East Boston.

A second East Boston yard, the Boston Graving Dock Corporation, is located on Jeffries Point east of the Massport Piers. This facility was purchased by Massport in 1986 and is operated since May 1987 under a 25-year lease arrangement by Cashman Marine Enterprises.

The General Dynamics Shipyard, located on the 35-foot Fore River Channel in Quincy, was one of the largest and most diversified shipyards in the country. However, this facility encompassing over 181 acres, closed in 1986. An effort to purchase the facility, made by a consortium of former shipyard employees was recently ended by an agreement between General Dynamics and MWRA for that agency's purchase of the site. MWRA proposes to convert the site to a construction staging and terminal area for construction of the new Deer Island Wastewater Treatment Plant. Proposals for future use of the site include a sludge processing facility and a regional trash-to-energy incinerator site. The lease of a portion of the site to the shipyard workers is being negotiated.

A fourth major facility, the General Shipyard Corporation is located in South Boston along the 40-foot Main Ship Channel. This facility operates the former South Boston Naval Annex Drydocks #3 and #5 and Piers #5, 6 and 7. The two areas abut the Massport Harbor Gateway Terminal to the east and west.

Commonwealth Pier, located in South Boston, was, until recently the only major passenger ship pier in Boston. With the conversion of this site to expanded convention center use, passenger terminal operations have been transferred to the new Black Falcon Cruise Terminal at the Boston Army Base Pier on the Reserved Channel. Warships visiting the harbor are berthed at this facility also, except those calling for repairs/refit and larger vessels such as the carrier USS John F. Kennedy, which because of its draft was forced to berth along the Main Ship Channel during it's September 1987 visit. The smaller carrier USS Inchon was able to berth at Black Falcon for its July 4, 1988 visit. In 1985 the passenger volume was 358,678 persons. In addition to this facility, two facilities provide sightseeing and charter excursion services around the harbor.

Massport operates a two ferry boat shuttle service between Rowes Wharf and Logan Airport. A passenger ferry provides transportation from Rowes Wharf to Provincetown on Cape Cod, Massachusetts during the summer months for tourists and year-round for commuters. Other shuttle services provide direct commuter connections to Hingham and Hull. The MDC and several private companies offer service between downtown wharves and the harbor islands for recreational use.

Boston Harbor, located within one of the major metropolitan areas of the Atlantic seaboard, is served by an extensively developed highway system. A series of Interstate and State routes provide overland access to major points along the entire Atlantic seaboard as well as major inland distribution destinations. State Route 128, now designated for most of its length as Interstate 95, is a multi-lane divided highway providing circumferential access around the metropolitan area. Interstates 95 and 93 provide overland access to all points in Maine and New Hampshire to the north connecting with Canadian Highways in Quebec and New Brunswick. Interstate 95 also extends south to all points as far as Florida. Interstate 90, the Massachusetts Turnpike, provides overland access westward across the State to the New York State line and thence continues to its terminus in Seattle, Washington. Additional principal numbered highways serving the area include State Routes 2 (west), 3 (south), 9 (west), 24 (southwest), and 138 (south) and U.S. Routes 1 (north and southwest), 3 (northwest), and 20 (west). The regional highway network is shown in Figure 7.

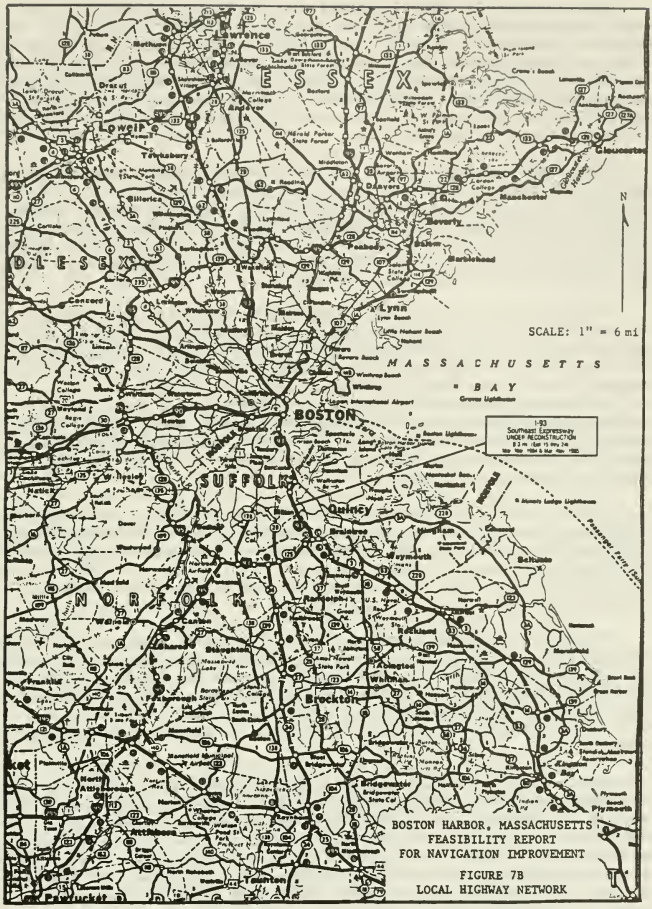
TABLE 13

PORT FACILITIES
PORT OF BOSTON

Purpose for which used	No.
Cargo handling:	
Bulk cement	3 (One at South Boston Marine Terminal, two on Mystic River)
Chemicals, petrochemicals, and solvents	1
Construction materials and equipment	2 existing (Perini) 2 proposed (Deer Island and Fore River)
General cargo - in foreign and domestic trades(1)	19
Gypsum rock, liquid sulpher and sulphuric acid (one each)	3
Petroleum products	29
Petroleum and Coal Products for Power Generation	2
Raw sugar	1
Refuse	2
Salt	2
Steel, steel products, and scrap metal	3
Seafood	10
Vegetable oil, liquid caustic soda, and silicate of soda	1
Marine Services and Repairs:	
Mooring	37
Mooring in connection with repairs, conversions, and outfitting	31
Not used for handling waterborne commerce	4
U.S. Coast Guard	2
Marinas	39
Unused facilities at time of survey	12
TOTAL	204

(1) One is a containerized, general cargo terminal, and two also handle containerized cargo.

BOSTON HARBOR, MASSACHUSETTS
FEASIBILITY REPORT
FIGURE 7A
REGIONAL HIGHWAY NETWORK



BOSTON HARBOR, MASSACHUSETTS
FEASIBILITY REPORT
FOR NAVIGATION IMPROVEMENT

FIGURE 7B
LOCAL HIGHWAY NETWORK

Boston Harbor is the terminus of two long-haul rail carriers, the Boston and Maine Railroad (Guilford Transportation Industries) and Conrail. The Boston and Maine Railroad serves cities and towns north of Boston to Maine and New Hampshire and west of Worcester. The Pennsylvania Central Railroad part of Conrail provides passenger (Amtrack) and freight service west through the major central points of the state into Albany, New York and to the south and southwest to Rhode Island and Connecticut and direct lines to New York City.

Overseas steamship services are provided by some 30 steamship lines operating in the Boston area. These services extend to virtually all parts of the world, linking Boston with nearly 150 world ports. Recent expansion of passenger terminals in South Boston by Massport is aimed at attracting more lines to Boston as a Port of call. In September 1987, the port hosted both the RMS Queen Elizabeth II and RMS Olympic. Both ships are scheduled for multiple fall 1988 visits.

The principal air facility in the area is Boston's Logan International Airport. This facility encompasses about 2,000 acres of filled land extending into Boston Harbor, and is the closest of any metropolitan U.S. airport to its downtown district. With the completion of the proposed Third Harbor Vehicular Tunnel scheduled for 2000, the airport will be directly connected to the shipping terminals of South Boston including the Reserved Channel. Cargo offloaded at South Boston terminals can be transferred by truck through the tunnel and loaded for shipping to inland destinations by air in a matter of only a few hours, greatly reducing transhipment times.

Other commercial airports in the area include: L.G. Hanscom Airport in Bedford, Beverly Municipal Airport, Danvers Airport, Norfolk Airport and Norwood Municipal Airport. The Massachusetts Port Authority operates both Logan and Hanscom Airports. Military air facilities in the area are located at Hanscom (AFB), Otis AFB on Cape Cod and the South Weymouth Naval Air Station.

The future of Boston's port activity will depend upon its ability to provide deepwater and safe passageway for vessels entering and exiting the port. The Port of Boston will continue to provide sea transportation services as New England's major commercial center in waterborne trade, as cargo handling efficiency, shipping services, storage facilities, and major inland markets are expected to continue to adapt to the commerce demands.

Boston is and will continue to be New England's major oil port. The trend of fossil fuel consumption to meet the region's energy demands is expected to continue unless alternate energy sources are developed. The construction of pipeline systems to transport petroleum products from the major sources, primarily the Gulf Coast, to the region have been rejected as economically and environmentally infeasible. The future activity of the port will continue to lie in the receipt of petroleum products as growth in the nonpetroleum industries is expected to be nominal.

One of the major commercial and industrial plans for the Port of Boston is for the redevelopment of the site of the South Boston Naval Yard site which is currently under construction. The site, with the exception of the waterfront parcel, is currently being developed by the city of Boston's Economic Development and Industrial Commission (EDIC), as the South Boston Marine Industrial Park, with an $80 million effort planned. The waterfront parcel has been filled and developed by Massport and is known as the Harbor Gateway Terminal.

There is also a plan for the modernization and rehabilitation of the Boston Fish Pier, the center of all fishing transactions for the Boston metropolitan area. A Foreign Trade Zone (FTZ) Boston Harbor, authorized by the U.S. Department of Commerce in April 1977, is planned to be constructed on 5.1 acres within the Boston Marine Industrial Park. This facility will employ people engaged primarily in light manufacturing, assembly, and packing.

The 1965/1975 city of Boston General Plan[1] identifies the upper shoreline of the Chelsea River in East Boston as an area for redevelopment or industrial use. Part of this area has also been identified as a conervation area under the Boston Urban Wilds Program.

The major plan for waterside redevelopment focuses on the former Charlestown Naval Yard. The yard was decommissioned in 1974 after 174 years of miltary service. The plan calls for the redevelopment of mixed uses, including a historic monument area including berthing for the Frigate USS Constitution and the decommissioned USS Cassin Young (DDE), public park, and also a mixed use area including light industry, hotel conference center, offices, housing, and a marina. Two former piers have already been converted as of 1987, one as residential condominium and the adjacent pier as a marina. The Boston Harbor Police occupy another of the piers.

The 1965/1975 General Plan for the city of Boston indicates the intention of redeveloping much of the East Boston waterfront for residential purposes. To date, Shore Plaza East, a 380 unit low and moderate income apartment complex, and a new school have been completed on Border Street. There are plans for mixed housing, commercial, and open space development of the waterfront below Maverick Square.

Existing Federal Project

In the interest of navigation, extensive modifications in the condition of the channels and ship maneuvering areas serving the Port of Boston have been undertaken and accomplished by the Federal Government. The existing Federal project for Boston Harbor is shown in Figures 8, 9

[1] The 1965/1975 General Plan for the city of Boston and the Regional Core. Boston Redevelopment Authority, 1964.

and 10. The existing Federal project for the Mystic River is shown in Figure 11.

The existing Federal navigation project for Boston Harbor is authorized by the River and Harbor Acts of 1825, 1886, 1892, 1899, 1902, 1913, 1917, 1935, 1945, 1946, 1958 and 1962, These acts combined to form the total project as it exists today to include:

1. A channel 40 feet deep in general, but 45 feet through rock, 900 feet wide, widening at the outer end to 1,100 feet from the sea to Presidents Roads, through Broad Sound;

2. Deepening the Main Ship Channel to 40 feet extending from President Roads to about 200 feet north of Mystic Pier No. 1, Charlestown, generally 600 feet wide with suitable widening at the bend opposite Commonwealth Pier No. 5, and 600 feet to 900 feet in the upper reaches. Length about 5.5 miles;

3. Deepening to 40 feet that part of the approach channel to the U.S. Navy Drydock at South Boston between the Main Ship Channel and the U.S. Harbor Line (The U.S. Navy funded the remainder of the access channel landward of the Harbor Line);

4. An anchorage 2,000 by 5,500 feet and 40 feet deep on the north side of President Roads to provide 250 acres, sufficient to accommodate three large vessels;

5. Extension of the President Roads Anchorage 700 feet to the north and about 500 feet to the west and 100 feet to the south (by narrowing the shipping lane) at a depth of 40 feet, to provide an additional 100 acres, for a total area of about 350 acres, 2800 feet by 6000 feet, sufficient to accommodate four large vessels.

6. Dredging an anchorage at the Lower Middle Shoal north of the 35-foot channel lane and west of President Roads to 35 feet, 5000 feet long and a maximum of 800 feet wide to provide about 67 acres of anchorage.

7. A channel 35 feet deep along the same line as the 40-foot main channel in the following manner, adjacent to the westerly side of the 40-foot Broad Sound North Entrance Channel, 600 feet wide, a distance of about 2 miles; adjacent to the northerly side of the 40-foot Inner Harbor Main Ship Channel from President Roads to abreast of the Fish Pier, 600 feet wide, a distance of about 3 miles; adjacent to the westerly and easterly sides of the 40-foot Inner Harbor Main Ship Channel from abreast of Fort Point Channel to the Charlestown Bridge at the entrance to Charles River, to the Mystic River Bridge and to the General Andrew P. McArdle Bridge, at the entrance to the Chelsea River having widths varying from 100 feet to 1,000 feet, a distance of about 2 miles;

8. A channel 30 feet deep, 2 miles long, 1,200 feet wide from the sea to President Roads through Broad Sound by a less direct southerly route than the 35- and the 40-foot channels, this is known as the Broad Sound South Entrance Channel;

9. A channel 27 feet deep and 1,000 feet wide from Massachusetts Bay through Nantasket Roads to President Roads, known as The Narrows Channel, 3 miles;

10. A channel 15 feet deep, 300 feet wide, and 550 feet long through the bar which extends from the north head of Long Island to Nixes Mate Shoal, known as "Nixes Mate" or "Nubble Channel";

11. A channel in Chelsea River 35 feet deep and generally 225 feet to 250 feet wide, from the mouth of the river at the head of the 35-foot channel in Boston Harbor to the Chelsea Street Bridge, and 250 to 430 feet wide above the bridge with a turning and maneuvering basin 35 feet deep, generally 800 feet wide and 1,000 feet long;

12. Deepening and widening of Reserved Channel to a depth of 35 feet and a width of 430 feet extending about one mile from the 40-foot main ship channel to the L Street Bridge;

13. The Fort Point Channel, 23 feet deep and 175 feet wide from its entrance in Boston Harbor to the Northern Avenue Bridge (The portion above Northern Avenue was declared nonnavigable and deauthorized in 1981);

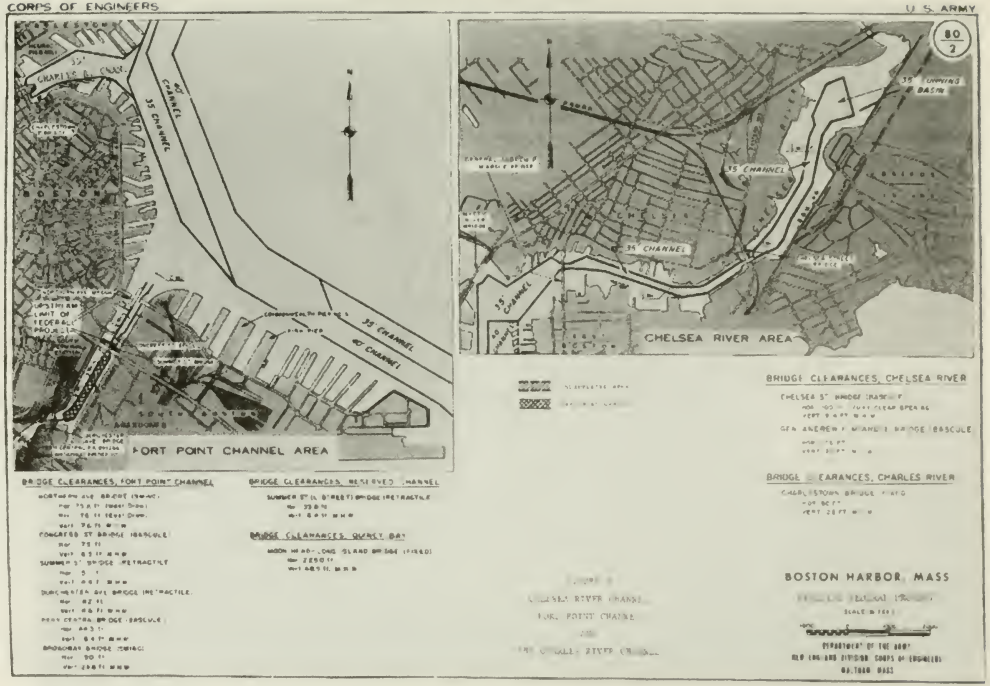
14. Seawalls of coursed stone, riprap and jetties protecting the most exposed headlands and islands (Deer, Lovell, Gallops, Castle, Long, Rainsford and Georges Islands and Point Allerton);

15. A channel 12 feet deep and 150 feet wide from the mouth of the Weir River in Hull Bay to the streamboat wharf (Nantasket Pier) at Nantasket Beach.

16. The Mystic River channel has been studied separately from the Boston Harbor channels in previous studies. The Mystic River area between the Maurice J. Tobin Bridge and the Malden Bridge has become one of the most active ocean shipping terminal areas in Boston Harbor. Therefore, it was reviewed as part of this study. The existing project is a channel 35 feet deep MLW extending from the upper limit of the 35-foot Boston Harbor Inner Confluence at the Mystic River Bridge to approximately 300 feet downstream of the Malden Bridge. The width varies from 940 feet at its lower end to about 1,060 feet at a point about 1,200 feet below the Malden Bridge, and then decreasing to 150 feet at the upper limit. A 20-foot channel extends through the bridge to a turning basin at Somerville. A small boat channel extends upstream to Medford.

The existing Boston Harbor project was completed in May 1966 with the last deepening of the Chelsea River Channel, except for completion to

BOSTON HARBOR MASS
35 FT CHANNEL
40 FT CHANNEL
30 FT CHANNEL
21 FT NARROWS CHANNEL
15 FT WEYMOUTH FORE RIVER CHANNEL
30 FT WEYMOUTH FORE RIVER CHANNEL
40 FT APPROACH CHANNEL
35 FT RESERVED CHANNEL
40 FT ANCHORAGE
EXTENSION
35 FT CHANNEL
35 FT AREA
40 FT ANCHORAGE
40 FT CHANNEL
18 FT DORCHESTER BAY CHANNEL
18 FT CHANNEL
LOCATION MAP
POINT ALLERTON AREA


CORPS OF ENGINEERS
U. S. ARMY
80
2
CHARLES R.
35' CHANNEL
40' CHANNEL
BOSTON
SOUTH BOSTON
FORT POINT CHANNEL AREA
35' TURNING BASIN
CHELSEA RIVER AREA
BRIDGE CLEARANCES, FORT POINT CHANNEL
BRIDGE CLEARANCES, RESERVED CHANNEL
BRIDGE CLEARANCES, QUINCY BAY
BRIDGE CLEARANCES, CHELSEA RIVER
BRIDGE CLEARANCES, CHARLES RIVER
BOSTON HARBOR, MASS

U.S. ARMY
CORPS OF ENGINEERS
MYSTIC RIVER MASS.
LOCATION MAP
BRIDGE CLEARANCES
MEDFORD
EVERETT
SOMERVILLE
CHELSEA
CHARLESTOWN
MYSTIC
RIVER
ROUTE 93 BRIDGE
MYSTIC AVE. BRIDGE
MYSTIC DAM
MYSTIC POND
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

FIGURE 10
NANTASKET CHANNEL
OR
WEIR RIVER CHANNEL

project width of the east side of the upstream end of the extension to the 40-foot Main Ship Channel along the East Boston shoreline which has been deferred.

That portion of Fort Point Channel above the Northern Avenue Bridge has been abandoned. All Federal dredging improvements in Boston Harbor are now in a maintenance status except the deferred portion of the 40-foot channel extension. The Federal cost for the completed project as of 1986 was $25,313,083 and maintenance costs through that year were $9,820,682.

Status of Existing Local Plans and Improvements

The South Boston Marine Industrial Park including Massport's Harbor Gateway Terminal is an $80 million development under construction along the Main Ship Channel's South Boston waterfront. The development will benefit both marine and nonmarine related industries.

Massport recently purchased the remaining East Boston deep draft piers which had been long abandoned and the Boston Shipyard Corporations facilities in East Boston. Both these facilities represent the last direct rail access shore facilities on the harbor available for significant marine-commercial development, and were purchased to ensure their continued availability for future marine industrial development. A $25 million reconstruction of piers #3 and #4 to house the port's commercial fishing fleet is underway. The East Boston Piers are shown in aerial photographs in Figure 12. The Boston Shipyard Facility is shown in aerial photographs in Figure 13. This facility is now known as the Boston Graving Dock Corporation and is operated under lease by Cashman Marine Enterprises.

The Port Authority has also begun expansion of the Moran Terminal on the Mystic River by acquiring the former B&M Railroad Yard, the Schiavoni Scrap Export Terminal and Revere Sugar Wharf. Direct sea-rail connections are being planned for this facility.

Design is currently underway on the Interstate 90 extension - Third Harbor Tunnel. This highway project will connect Logan International Airport with the Massachusetts Turnpike's present terminus at I-93. The tunnel portion of the project will cross beneath the Main Ship Channel from the Massport Marine Terminal in South Boston to the Bird Island Flats area of Logan Airport. The tunnel's planned depth will have no impact on the existing 40-foot Main Ship Channel depth. However, the tunnel elevations as presently proposed will represent a permanent restriction to further harbor improvements beyond -40 feet in reaches above the Harbor Gateway Terminal.

FUTURE CONDITIONS (WITHOUT-PROJECT)

If no Federal action is taken in improving the general navigation system within the Port of Boston, the present effectiveness of the harbor and its potential future development would be adversely affected. Boston Harbor is the major New England shipping port and a reduction in the movement of commodities through the port would have significant impacts on the regional and the northeastern U.S. economy. Several potential future impacts that would result if no Federal action is taken should be considered prior to determining future conditions. These impacts include harbor effectiveness, safety and environmental factors.

Without an improvement project, effective and efficient utilization of the harbor will be reduced. Current trends in ocean shipping indicate that larger vessels will be built and smaller vessels phased out of service. The larger vessels will not be able to utilize the existing navigation system effectively, thereby causing shippers to consider other more costly shipping methods than at present such as increased use of lightering.

An important future consideration is the level of safety in navigating the harbor. Boston Harbor has been fortunate in terms of shipping accident frequency, with no major accidents having occured in this century. Present conditions include split depths in channels, deeper channel sections in the outbound portions of channels, and limited channel dimensions and alignments. Future use by vessels larger than those presently in use could increase the risk of a navigation accident occurring in Boston Harbor. A reduction in safety would also preclude shippers from risking damage to their vessels.

Consideration of safety has a direct correlation to potential future environmental conditions. The grounding of a large tanker would have a significant impact on the entire harbor and Massachusetts Bay from an environmental point of view. Without the improvement, as vessel sizes increase, lightering activity in the anchorage will increase, adding the potential for small oil spills on a daily basis. Because of larger vessels transiting the existing project, the potential impact of any single spill incident will increase while the potential for an accident will decrease due to fewer vessel trips. The primary commodities shipped through Boston are petroleum products. These two potential environmental hazards can be reduced by making improvements to the navigation system.

It would be unrealistic to assume that Boston Harbor would completely stagnate because of a lack of Federal action. LNG, petroleum, bulk container cargo, and other imported commodities would continue to be brought into the area by some means. This would probably be accomplished by smaller lighter vessels or by extreme tidal navigation. If no improvements are made, commercial ship traffic will not in any way die out in Boston Harbor. The current investments in storage capacity and loading and offloading facilities in the harbor will preclude this. But growth

View to East Along Main Ship Channel
June 8, 1987 By Mark Habel

View to Northeast to Logan Airport
September 17, 1985 By Mark Habel

View to North Towards East Boston - September 17, 1985
By Richard DeSimone

(Pier #3) (Pier #4)

BOSTON HARBOR, MASSACHUSETTS
FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT
FIGURE 12
MASSPORT'S EAST BOSTON PIERS

View to Northwest Across East Boston Towards Charlestown
September 17, 1985 By Mark Habel

View to North towards Jeffries Point Neighborhood
September 17, 1985 By Richard DeSimone

BOSTON HARBOR, MASSACHUSETTS
FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT

FIGURE 13

BOSTON SHIPYARD CORP. SITE

and development of the harbor will be hampered. The physical constraints of the harbor presently limit the width and depth of some plans, but some changes could be made to improve the efficiency of the harbor. If no action is taken, large vessels (25,000 DWT+) currently utilizing Boston Harbor will continue to experience tidal delays. Some will tolerate this, and some will try to avoid such delay by utilizing smaller vessels, lightloading or lightering. Whatever means are used to cope with the current unimproved navigation system, they will result in a net increase in transportation costs due to additional handling and/or transport distance as average fleet dimensions increase over time.

Possible channel improvements implemented by local interests appear to be highly unlikely due to funding constraints. The Commonwealth is currently faced with significant funding requirements for several Metropolitan area projects including the $3 billion Third Harbor Tunnel and Central Artery Depression, and the currently estimated $6 billion Deer Island Sewage Treatment Plant and Boston Harbor cleanup. Minimal localized improvements such as berth deepening could be made by local interests, but implementation of an overall plan would be more consistent with Boston Harbor needs.

The future condition forseen for Boston Harbor is one of an active port, but with restricted activity and little potential for further growth in bulk cargo receipts and shipments. The existing navigation system would remain the same as it is now with possible minimal improvement. With more frequent future use of the existing navigation system by larger vessels the potential for shipping accidents may increase, however, use of larger vessels to satisfy the same demand will result in fewer trips through the harbor.

Environmental Improvements Projected

Boston Harbor is currently the focus of a concerted effort to improve the harbor ecology. A court ordered timetable is set for implementation of a new primary and secondary sewage treatment plant for the metropolitan area to be constructed on Deer Island. With the new plant, storm induced dumping of raw sewage into the harbor will cease. The elimination of point discharges and combined sewer overflow will take place as the new plant comes on line in the 1990's. The major outfall, now off Deer Island in the Outer Confluence, will be relocated further offshore in Broad Sound.

Continued improvement of discharge regulations together with increased state enforcement and pretreatment will further reduce point discharges of contaminants. Construction of hazardous waste disposal facilities will decrease illegal disposal of such substances into harbor waters. Regulations aimed at providing increased sewage pumpout facilities for small craft will also help by decreasing the discharge of raw sewage from this source. Water quality in Boston Harbor is thus expected to increase steadily over the next several decades. The past

pollution of harbor sediments will, however, continue to contribute to the degradation of water quality as contaminants are released into the water column by physical and biological activity. Declines in releases from this source will occur over a much longer timeframe.

Lightering of petroleum vessels will continue with its inherent minor discharges of petroleum into the harbor's waters. The potential for petroleum carrier grounding will continue to exist.

Changes in Fleet Characteristics

The continued trend toward larger vessels in the world fleet will result in a general aging of the fleet currently calling on the port of Boston. As the smaller, older carriers are phased out of service and replaced by larger vessels, the average tidal delay and need for lightering will increase. This will increase the transportation cost for all petroleum products. The institution of segregated ballast requirements for new vessels so as to reduce pollutant discharges will also increase transportation costs, since DWT capacity will be reduced for each class of ships.

It is possible that greater volumes of petroleum products will be brought to Boston via rail or interstate highway at increased cost. Reduced rail and highway safety will result should this occur as will increased maintenance costs for these land transportation systems.

Proposed Local Development

It is anticipated that Massport will continue to acquire property along the waterfront in more remote areas such as the tributary channels and East Boston so as to sustain a maritime use. The authority cannot, however, always compete financially for properties with non-waterfront dependant development interests as evidenced by the proposed conversion of the South Boston Fan Piers to a $1 billion mixed hotel-retail-residential complex. The Fan Piers location is a large rail accessed property along the 40-foot Main Ship Channel.

Chelsea Street Bridge Improvements

Reconstruction of the Chelsea Street Bridge fender system by the City of Boston is scheduled to begin in the winter of 1988-1989. The $2.4 million project will replace the dilapedated 10 year old wooden fenders with a steel pile-wooden wale structure backed up by cellular sheet-pile dolphins. The steel structure would have a 20-30 year life. A navigation opening of 96 feet will be provided. Once the new fenders are in place, the US Coast Guard's restriction on vessel beams will be reconsidered and the threat of daily fines to the city lifted. The existing 35-foot Federal channel would then be widened at that depth to the full width between fenders. It is expected that vessels with beams of up to 90 feet, the pre-restriction maximum, would once again call on terminals upstream of the bridge.

PROBLEMS AND OPPORTUNITIES

Historically, the general economy of the Boston area and New England has been influenced by shipping activities of the Port of Boston. The existing navigation channels are inadequate to accommodate the larger bulk carriers presently calling at the port because of draft requirements. Similarly, changing terminal pattern activities within the port area now require increased channel depths in areas previously servicing smaller sized vessels.

As a larger percentage of the vessels that make up the world fleet continue to increase in size, transportation costs will increase for shipping lines forced to utilize the restrictive channel depths and width in Boston Harbor. The deeper draft of the larger vessels in service has reduced the operating economy for the Port of Boston, due to the time delay while waiting for sufficient depth of water at high tide to transit harbor channels. The Port of Boston is in reality a tidal port for most larger vessels requiring 32+ feet of water at Mean Low Water since most active terminals are located along the 35-foot tributary channels.

Problems with Navigation

Discussions with local interests currently utilizing the Port of Boston established that the major perceived problem areas attending deep draft navigation in the Port of Boston are:

1. Restricted Width and Depth of the Broad Sound North Entrance Channel including the Finns Ledge Turn

2. Restricted size and depth of the President Roads Anchorage

3. Restricted Width of Inner Harbor Main Ship Channel particularly at the Spectacle Island and Lower Middle Shoal Turns

4. Restricted Depth in Major Tributary Channels (Mystic River, Chelsea River and Reserved Channel)

5. Restricted Depth and Dimensions of Confluence, Turning and Maneuvering Areas.

6. Restricted Channel width in the Chelsea River, particularly through the Chelsea Street Bridge.

The following sections discuss in more detail the above identified nevigation problems. Upon examination of the problems, potential opportunities for improvement of harbor efficiency were identified.

President Roads Anchorage (Anchorage #2)

The Boston Pilots have strongly recommeded that President Roads Anchorage #2 be deepended to 45 feet over its entire dimensions and enlarged. If the cost of such a deepening is prohibitive, the Pilots recommend that the easterly half of the anchorage be deepended to 45 feet.

During the study, comments were raised by the Federal Aviation Administration (FAA), and Airline Pilots Association regarding the safety hazard posed by ships utilizing President Roads Anchorage and their obstruction of the runway approach lanes for aircraft landing at Logan International Airport. At a public hearing held by the Commander, First Coast Guard District, the FAA, Massport, maritime industry representatives, Airline Pilots Association, and harbor pilot interests participated in a discussion relating to a proposed rule making to amend anchorage regulations for Boston Harbor. These new rules would have excluded certain vessels with unusually high masts from certain portions of the anchorage area.

Airline interests contended that adoption of the amendment would increase airport operating time as much as forty hours per year, depending on variable weather conditions, which would bring more revenue into Logan Airport, and reduce the cost and inconvenience of diverting some flights to other destinations. Marine interests argued that vessels affected by changing regulations would be exposed to greater safety hazards. The potential for pollution of shores and adjacent waters by oil spills would increase because a greater number of lightering operations would have to be conducted outside of the protected waters of the harbor anchorage grounds. Maritime interests pointed out, and the Coast Guard agreed, that adoption of the amendment reduces potential revenue to the Port of Boston by restricting the size of vessels that may anchor in the anchorage areas. In view of the arguments presented, the Coast Guard determined that the rule making action of the proposed amendment was not appropriate at this time, and notice CGD-76-4D would be withdrawn. The withdrawal of the proposal, however, does not preclude the Coast Guard from considering similar action in the future.

In a harbor as extensive as Boston it is necessary that somewhere along the inbound route used by large deep-laden vessels navigating the Inner Harbor, that there exist an anchorage and, or a turning basin, with the capacity for anchoring and turning the ships in the event of mechanical failure, insufficient tug support, lightering, tidal delay or dense fog. An exception to this concept would be the case wherein tugs would accompany the ship along the entire route. Even this procedure would not be an appropriate response to the reduced visibility situation. Elimination, or restrictions, placed on the use of the existing anchorage would mean reduced economic benefits from overall navigation improvements and questionable safety operations. Investigation of the current status of President Roads Anchorage #2 with the Coast Guard revealed that no consideration, or action, is contemplated for changing the status of the

anchorage. No change in status for the state-maintained 30-foot Bird Island anchorage (#1) is comtemplated either.

Alignment Of Channel

The overriding requirement for channel alignment is that all vessels expected to use the channel should be able to navigate it with reasonable safety under adverse conditions of tide, current, and wave and wind action in the channel. Turning ability of the vessel is dependent upon rudder response, thus adequate steerageway and depth under keel are necessary to assure design rudder response. Furthermore, external forces upon the ship can reduce control greatly, increase the turning radius required, and lengthen the time and distance necessary to complete the maneuver. Critical locations for a ship navigating a channel are at ocean entrances, bridges, and approaches to locks, barriers, and control structures. At these locations, straight approaches long enough for vessels to become properly aligned are a necessity. Boston Harbor channel alignment problem areas are located at the ocean entrance, and at the entrance to the Main Ship Channel from President Roads Anchorage.

Bends in channels are more difficult to navigate than straight channels because of reduction of clear sight distance and reduced effectiveness of navigation aids, constantly changing headings of the ship resulting in difficulties in fog or strong winds, cross currents and bank suction forces, changing channel sections create changes in strength of current, and the rudder and centrifugel force on a vessel making a turn tends to displace the stern to a path outside of the path of the bow. The bend in the Broad Sound North Channel which must be negotiated at speeds approximately 7-8 knots to maintain steerage was constructed with a deflection angle of approximately 26^{o}. Channel width at this turn clearly establishes the channel for one-way traffic only, thereby restricting all ship movement in and out of the Port of Boston when a large deep-draft vessel is negotiating entry or exit.

To correct perceived deficiencies in alignment effecting larger vessels operating in restricted channel widths, deep-draft channel users have requested widening of the channel at the first bend in the Broad Sound North Channel, and the first bends in the Main Ship Channel from President Roads Anchorage.

Need For Greater Channel Depth

The locations of major deep water maritime activities in the port has shifted, since the Inner Harbor channels were last modified. The current make-up of the Port's major terminals are predominantly liquid bulk facilities located along the Reserved Channel, the Mystic River, and the Chelsea River. A 600-foot width of the Main Ship Channel, and a 900-foot width of Broad Sound North Channel were improved in the past to provide 40 feet of water at MLW and specifically to accommodate the Main Waterfront along the downtown Boston, South Boston and East Boston waterfronts.

These areas no longer support deep water terminal activities, whereas, the Mystic River, Chelsea River and Reserved Channel which provide only an operational depth of 35 feet at MLW, now are the active working areas of the port. Deep-water facilities development and operation is now concentrated on the Mystic River Channel and Chelsea River Channel, Reserved Channel, and along the South Boston reach of the Main Ship Channel. The effective depth of water available in the major portion of the working harbor today in the Port of Boston is only 35 feet at MLW. This depth is not sufficient to ensure efficient and economic navigation for current traffic or the future vessel fleet operating in the Port of Boston.

An important desire on the part of the maritime interests using the Port of Boston is that large vessels loaded to full capacity may sail directly to their destination upon entering or leaving the port, and without regard to the tide. With an operational depth of 35 feet MLW, liquid bulk vessels travelling at lower tides cannot exceed 25,000 DWT to meet loaded draft requirements, or must be light loaded if 30,000 DWT, or larger. Thus, a 30,000 DWT tanker, capable of being loaded to a draft of 34 feet, which has to enter or leave the port drawing only 31 feet, loses the most profitable part of the voyage. The additional 3 feet of draft carries approximately one-third more cargo, with comparatively little increase in cost to the carrier. To compensate for this condition, the 30,000 DWT and larger class of vessels entering the port are forced to navigate existing channels with tidal assistance and immediately discharge to lessen draft requirements to meet low tide conditions. The fact that the small 30,000 DWT class of tankers cannot navigate in the deep-draft working areas of the port, the Mystic River, Chelsea River, and Reserved Channel, without benefits of the tide identifies the true plight of shipping in the Port of Boston.

The magnitude of the channel depth problem focuses on the ocean entryway into the Port of Boston. The depth of the Broad Sound North Entrance Channel, the deepest entrance to the Port of Boston, governs the critical operating characteristics for deep-draft vessels entering the harbor. Although a nominal 40 feet of depth has been provided for a width of 900 feet through the greater portion of the channel, the width extends to 1100 feet at Finns Ledge bend at the entrance, and ledge areas dredged to 45 feet, there is insufficient effective operating depth to permit vessels approaching 40 feet of draft to enter the harbor to reach the 40 feet of water available in President Roads Anchorage, and the Main Ship Channel at all stages of the tide. Experience has established that adequate depth is the first requirement of safe navigation in a waterway. Channel depths greater than the loaded draft of vessels using exposed waterways are required in order to ensure safe and economic navigation. A vessel in motion through the entrance channel will sink, or "squat", an amount depending on: (a) the speed of the vessel through the water, (b) the distance between the keel and the bottom, (c) the trim of the vessel, (d) the cross sectional area of the channel, (e) the pitch and roll resulting from sea conditions, (f) whether the vessel is passing

another vessel, and (g) other ship and channel characteristics. A 5-degree angle of roll for a ship having a beam of 100 feet, the size of the bulk carriers in service on the Mystic River and Reserved Channel, would increase amidships draft about 4.4 feet. This is not an unusual roll at entrances, resulting from wind and turn angle even in semiprotected conditions. Boston pilots attempt to minimize this roll by using rudder movement to counter the tendency to roll. In this type of exposed conditions, a pitch angle of 1.5 degrees in a 730-foot vessel would increase draft forward by approximately 7 feet in heavy seas. The limited depth of the entrance channel also produces violent flow patterns under the keel of the deep-draft vessel making the vessel hard to handle and requires large rudder angles, unless speed is considerably reduced, which in turn affects steerage.

Due to current depth restrictions, harbor pilots use tidal navigation to bring larger vessels into the harbor. Mean high water (MHW) averages 9.0 feet in the outer harbor and 9.4 feet in the inner harbor while lowest high water (LHW) averages 7.6 and 7.8 feet, respectively. Vessels of up to 39.5 feet in draft can be brought in around the high tide regardless of high water level by beginning transit 1.5 to 2.0 hours before high tide so as to be in the upper harbor channels for offloading no later than one hour after high water. A 39.5-foot vessel needing 3 feet underkeel would be accomodated by the 35-foot channel with 7 to 8 feet of tide. This current and without-project condition practice results in excess available depth in the 40-foot entrance channel where 5 feet of additional depth is available, whereas only 2 additional feet of underkeel (total 5 feet underkeel) is needed. Without deepening of inner harbor channels, the excess depth available in the entrance channel would continue to go unused, and the existing draft limit of 39.5 feet would remain the norm.

Need For Improvement Of The Mystic River/Chelsea River, Inner Confluence, and Reserved Channel.

At the present time, the larger, deeper draft vessels attempting to navigate the upper reaches of the Main Ship Channel into the Mystic River terminal areas during flood tide, must negotiate the confluence of the Mystic River and Chelsea River known as the Inner Confluence Area. These vessels are larger than those for which the 35-foot improvements of the 1950's and 1960's were designed. This restricted channel area is bordered on the west by the Tobin Memorial Bridge (Mystic River Bridge) and the land masses of Charlestown, East Boston, and Chelsea. Container and LNG vessels approaching 900 feet in length are forced to maneuver up into the Chelsea River Channel to effect a turn into the Mystic River. LNG vessels and larger tankers are turned below the Mystic Bridge to face bow to the sea prior to berthing for unloading hazardous cargo. Large container ships servicing the Massachusetts Port Authority Moran Terminal employ this same technique so as to facilitate movement out to the sea after cargo transfer. Smaller vessels and those calling on berths in the Island End River Commercial Channel and berths perpendicular to the Mystic Channel upstream of Moran, turn in the Mystic Channel itself.

Vessels calling on terminals in the lower Chelsea River will turn in the Inner Confluence, either when inbound or outbound. Vessels calling on terminals upstream of the Chelsea Street Bridge use the upper turning basin at the head of navigation.

Project dimensions of this maneuvering area must be enlarged to accommodate the larger class of vessel which would use the Mystic River and Chelsea River if improvements to depth were provided. In addition the authorized depth, 35 feet at MLW does not provide sufficient water depth to accommodate deep draft vessels at all ranges of the tide. In order to reach their 36 to 42-foot berths provided at the terminals in the Mystic River Channel and Chelsea River Channel, deep draft vessels presently entering the Mystic, and Chelsea Rivers are required to navigate this portion of the Main Ship Channel during stages of the flood tide.

Need For Enlargement of Entrance To Reserved Channel

The larger deep draft vessels, ranging 800-900 feet in length, experience great difficulty in maneuvering into the Reserved Channel. Boston Pilots report a hazardous condition at the entrance to the Reserved Channel involving the 35-40 foot split depth of the Main Ship Channel. The 35-foot improvement of 1960 was not designed to accomodate vessels of this size. Vessels moving up the Main Ship Channel approaching the entrance to the Reserved Channel must reduce speed to negotiate the turn with resulting loss of steerage. Pilots attempt to swing the stern of the vessel across the Main Ship Channel to align the vessel into the Reserved Channel. With the loss of steerage, tidal currents tend to carry the vessel further up the Main Ship Channel into ledge off the former Boston Army Base.

Upon departure, vessels that enter the Reserved Channel bow to, must be turned seaward when reaching the Main Ship Channel. The restrictive dimensions of the Reserved Channel and the Main Ship Channel at this junction pose a continuous grounding threat for deep draft vessels attempting to back across, and upstream into the 600 x 40 foot section of the Main Ship Channel to effect this turning maneuver, in addition to blocking the main navigation channel to ship traffic. Terminal operators in the Reserved Channel prefer vessels to be turned bow to the sea prior to entering the Reserve Channel. In the event of an emergency, or if tugs are not available, this berthing procedure permits the vessel to exit the port without tug assistance.

Pilots and channel users have requested that an area between the Main Ship Channel and Reserved Channel off the Boston Army Base Pier be dredged to a depth of 40 feet at MLW, to provide an area for conducting this turning maneuver. Pilots have also suggested that the Main Ship Channel be also widened at this junction to facilitate this maneuver. With a 35-foot depth in both the Reserved Channel and opposite side lane of the Main Ship Channel an area of at least 1200 feet in width at that depth is

available in which to accomplish this maneuver. However if the Reserved Channel were to be deepened, a similar area must also be deepened at the confluence to allow vessel access at that greater depth.

Need for Greater Channel Width

The navigation of a channel is a very difficult operation. Accidents can occur due to human or equipment inadequacies or due to channel inadequacies. Some Boston Harbor channels are overly wide, having been designed during periods when steam-sail vessels were still in wide use, requiring wider maneuvering allowances. However, with increasing vessel size and cost, inadequate navigation channels must be enlarged, but not unduly so. If channels fail to keep pace with the increase in vessel size, accidents can take place.

The risk of an accident involving a major vessel at Boston Harbor is difficult to quantify. No major accident has occured in the port since sailing vessels were phased out of service at the end of the last century. The use of harbor pilots, tugs and modern electronic positioning devices makes the possibility of a major incident remote. While minor difficulties attending the navigation of large vessels exist, and are subsequently detailed, no inherently unsafe conditions were identified. The low frequency of vessel trips, two to four per day, makes one-way traffic manageable. Significant increases in vessel arrivals are not envisioned during the study period. Therefore two-way traffic conditions and the requirement for overall channel widening are not considered necessary.

The Broad Sound North Channel last underwent a design analysis in 1915 as part of the 40-foot deepening authorized in 1917. This entrance to Boston Harbor for deep-draft vessels, has an entrance width of 1,100 feet, and a nominal 40-foot depth to the first bend where it splits into two parts. On the inbound or right side (starboard) when looking landward, the channel is 35 feet deep and 600 feet wide. On the outbound or left side (port) when looking inland, the channel is 40 feet deep and 900 feet wide. Only the outer edges of this split depth channel are marked by buoys. This channel condition is maintained to President Roads.

The Main Ship Channel upstream from President Roads Anchorage is also a split channel similar to the Broad Sound North Channel which was designed as part of the 1935 authorization. On the inbound side, it is 35 feet deep and 600 feet wide; on the outbound side it is 40 feet deep and 600 feet wide. This split channel condition exists up to a point abreast of the South Boston Fish Pier. At this point the depth of the entire channel width of 1200 feet is 40 feet. From abreast of the old Fort Point Channel up to the Charles River, the channel again has a split depth as authorized in 1945; the inbound lane is 40 feet deep and 600 feet wide the outbound lane is 35 feet deep and 600 feet wide. From the Charles River to the end of the Main Ship Channel, a 40-foot depth is available with a width ranging from 600 to 900 feet. A portion of this channel has a depth

of 35 feet along both the inbound (East Boston) and outbound (Charlestown) sides. Physical restriction of channel width in this reach is caused by the East Boston and Charlestown land masses.

Finns Ledge

The Finns Ledge bend in the Broad Sound North Entrance Channel which must be negotiated at speeds approximately 7-8 knots to maintain position was constructed with a deflection angle of approximately 26°. The two turns in the Main Ship Channel leaving the President Roads Anchorage inbound have deflection angles of approximately 20° and 22°, respectively. If the channel in these reaches is not widened, widths at these turns clearly establish the existing deep draft portion of the channel for one-way traffic only, thereby restricting all ship movement in and out of the Port of Boston.

The Emergency River and Harbor Act of June 6, 1900 provided for survey of Boston Harbor, with a view of providing channel 2000 feet wide, or such width as may be necessary, and 35 feet deep from President Roads through Broad Sound to the Ocean. This survey was completed on November 29, 1900 and showed a possibility of three routes which could be considered for such a channel. The route selected was an area further to the northwest of the existing Broad Sound South Entrance Channel, just east of the Great Faun Bar Beacon off Deer Island. No ledge was discovered in the proposed channel area. A ledge, however, was discovered during the hydrographic survey about 3/4 of a mile seaward of the limits of dredging with an elevation of -27 feet at MLW. It was estimated that the removal of this obstruction would require the excavation of 5100 cubic yards of rock to an elevation of -35 feet. The ledge was named Finns Ledge for United States Hydrographer Thomas J. Finn who directed the operations of the soil boring parties. The project was modified to provide a 1500-foot by 35-foot channel 1-1/2 miles long and was approved by the Act of June 12, 1902. Dredging was completed in January 1912, with the exception that Finns Ledge was not removed.

On July 25, 1912, a River and Harbor Act provided for an examination and survey to provide a deeper channel from President Roads to the ocean. A survey was first undertaken on Finns Ledge, which had not yet been removed under the existing authority, and was completed in 1913. A 36-foot MLW contour of the ledge was found to cover an area of approximately 80,000 square feet. A decision was made by the Chief of Engineers to locate the deeper channel to the eastward of Finns Ledge, and to use the ledge as the foundation for a lighthouse and was, therefore, omitted from the project. The River and Harbor Act of August 8, 1917, provided for a channel to be constructed from President Roads to the sea, 900 feet wide, with a bend at the outer end, and 1100 feet wide at the entrance east of Finns Ledge, 45 feet deep through rock and "of a sufficient depth to insure safe navigation at mean low water for vessels requiring 40 feet draft in the inner harbor." The dredging of Broad Sound North Channel to -40 feet was completed on August 8, 1930 but the removal

of Finns Ledge was not included in the project. The U.S. Coast Guard elected not to construct the recommended lighthouse on the ledge in the mid-1920's.

Finns Ledge, a rock formation of relatively small area, is in the direct channel lane from President Roads to the ocean and presents a limited navigation problem for the larger vessels entering or leaving the Port of Boston. The entrance reach of the Broad Sound North Entrance Channel is effectively reduced to one-way traffic by larger vessels negotiating the bend and staying clear of the ledge area. The problem is reported to be acute during adverse weather conditions, when sea conditions in the area are severe. Vessels as small as 30,000 DWT must proceed with extreme caution with pilots arranging for transit at a time to avoid other vessel movements in the area. The current limited traffic volumes in the Port of Boston, however, allow one-way traffic for larger vessels to be the rule, without significant delays for a clear channel. The number of situations in which the bend limitation could pose a problem is not considered significant. No vessels have failed to call on the port due to this restriction and no incidents of collision or near-miss have been reported.

Opportunities for Improvement

President Roads Anchorage - The anchorage can be deepened to allow larger vessels to utilize the harbor for lightering operations. The relatively well sheltered anchorage would also be utilized to anchor vessels while waiting for favorable tides, or the movement of other harbor traffic, (e.g., LNG tankers).

Need for Greater Channel Depth - Additional channel depth in the Mystic River, Chelsea River and Reserved Channel will allow for more efficient and safe use of the navigation system. Deepening of these upstream channels would also allow larger vessels to sail directly to their destinations, with eliminated or reduced tidal delay and lightering requirements, thereby increasing efficiency of operation. Deeper drafted vessels than those now commonly calling on the port could due so by riding the tide once interior channels were deepened.

Alignment of Channel - Modification of channel alignments in several areas would increase the level of safety and efficiency in transiting the navigation system. As ships get larger they become less maneuverable, therefore, requiring additional space to manuever. Particular areas that are opportune for modified alignments are the Broad Sound North Channel at Finns Ledge, and the two Main Ship Channel bends upstream of the President Roads Anchorage.

The bend in the Broad Sound North Entrance Channel could be eliminated by removing the southeast portion of Finns Ledge or turning could be eased at the bend by dredging a bend cutoff opposite the ledge. Turning at the Charles River, Spectacle Island and Lower Middle Shoal

bends in the Main Ship Channel could be similarly eased by dredging bend cutoffs on the inside of the turns. Harbor Pilots have recommended a minimum widening of 150 feet in the Main Ship Channel reaches #1 and 2, between President Roads and the crossover area.

The present traffic volumes in Boston Harbor require only one-way traffic. Significant increases in traffic volumes are not anticipated in the near-term. Harbor safety is not appreciably compromised by the existing turn restrictions at these points. No measureable benefits would result from modifications at these channel bends.

Need for Greater Channel Width - Future vessels are expected to have increased beams as newer designs come into use. Wider channel widths would allow for larger vessels to use the channels more safely and efficiently.

Increased use of the larger classes of bulk carriers now calling on Boston is expected should tributary deepening occur. With no significant increases projected in the demand for petroleum products, the use of larger vessels would result in reduced deep-draft vessel traffic. The need to provide for two-way traffic in Boston Harbor is not expected. Therefore, significant measureable benefits would not result from channel widening.

Need for Widened Channel Confluences Improvement of harbor maneuvering areas would provide an opportunity to increase present efficiency and enhance future development. The amount of vessel maneuvering presently necessary in the Mystic River/Chelsea Inner River Confluence Area and at the Reserved Channel's confluence with the Main Ship Channel can be reduced and made safer with the appropriate maneuvering area and channel widening improvements.

To summarize, the potential opportunities for improving navigation at Boston Harbor center around improving navigational efficiencies for the deep-draft bulk carriers now in use at the port. Deeper channels and provision of wider maneuvering areas at channel confluences would allow for more efficient use of these types of ships and use of larger vessels with tidal assistance, thereby reducing the cost of transporting bulk commodities.

PLANNING CONSTRAINTS

In developing management measures that would solve the problems and fulfill the identified needs, consideration must be given to certain constraints known to exist, that limit the available scope of solutions. These constraints will therefore direct the plan formulation process. Planning constraints may be brought about because of the existing physical conditions, the existing state of the art, institutional limitations (including legislative acts), impact upon local groups, and economic and environmental limitations. The following planning constraints were considered during the plan formulation process.

Physical Constraints

Tunnels

The Massachusetts Turnpike Authority requires that at least 10 feet of overburden must be maintained over the Sumner and Callahan Tunnels, which cross under the Main Ship Channel between the North End and East Boston, in order that they maintain their engineering integrity. This requirement limits the extent of deepening permitted as costly relocation work would be necessary with vast impacts on vehicular traffic. Therefore, the depth of the channel is limited to 40 feet in the Main Ship Channel in the vicinity and upstream of the tunnel crossings, including the tributary channels in the Mystic River, Chelsea River and Inner Confluence.

The MBTA's rapid transit Blue Line Subway Tunnel crosses beneath the harbor channels downstream of the two existing traffic tunnels. It crosses beneath the East Boston shoreline immediately upstream of the upstream berth at Massport's East Boston Pier #1. This tunnel represents the greatest restriction, precluding any deepening beyond the existing 40-feet, above this point.

While it may be possible to excavate to depths approaching the tops of the tunnels and place some sort of protective cap above them to permit channel deepening, such a scheme may not be practical. Given the age and primitive construction techniques used, especially on the MBTA and Sumner Tunnels, it would probably not be prudent to disturb the structures. In order to deepen the harbor channels above the tunnels it is therefore assumed that the three tunnels would be replaced by a new tube or tubes. Based on the proposed 3rd Harbor Tunnel cost, estimated by MA DPW at about $2 billion, the annual charge for such an undertaking would clearly preclude justification of channel deepening beyond 40 feet in upstream areas.

Currently under design and soon to begin construction is the Third Harbor Tunnel/I-90 extension. It will cross beneath the Main Ship Channel from South Boston in the vicinity of the Harbor Gateway Terminal, and thence to Bird Island Flats in East Boston. The tunnel will be placed at a depth which will allow for any future widening of the Main Ship Channel to the full 1200-foot width at a 40-foot depth. As presently designed, however, the tunnel's elevation would prohibit any future deepening of the harbor above the Harbor Gateway Terminal.

As the three existing tunnels cross beneath the Main Ship Channel upstream of the Fort Point Channel and the East Boston Piers location, they would not affect any future Main Ship Channel deepening beyond 40-feet up to this point. The locations of the three existing tunnels and the proposed I-90 tunnel are shown in Figure 14.

Bridges

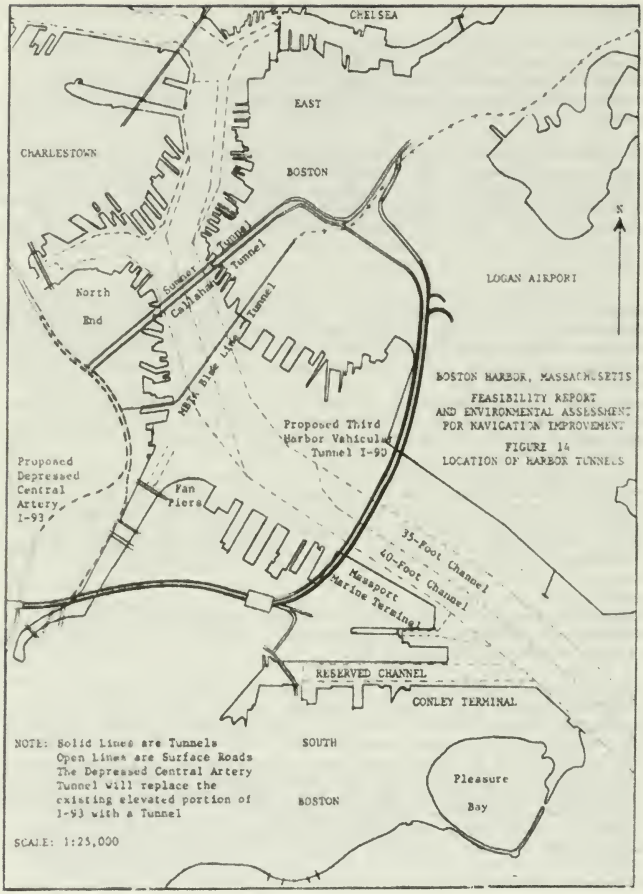
There are three bridges which cross the Federal Channels being considered for modifications. The Mystic-Tobin Bridge crosses at the entrance to the Mystic River Channel. Two other bridges, namely the A.P. McArdle Bridge and the Chelsea Street Bridge cross the Chelsea River Channel.

The Mystic River - Tobin Bridge crosses the Mystic River Channel immediately upstream of the boundary with the Inner Confluence Area. The bridge piers which provide a horizontal clearance of 690 feet are not fendered. The Federal Channel widths at this point is 600 feet. The bridge is a fixed span with a vertical clearance of 135 feet MHW and poses no significant restriction on navigation or the scope of improvements being considered in this report.

The downstream most of the two bridges crossing the Chelsea River Channel is the A.P. McArdle Bridge. Aerial photographs of this bridge are shown in Figure 15. This bridge, which crosses the channel immediately upstream of the boundary of the Inner Confluence area, is a double leaf bascule, completed in August 1954 and owned and operated by the city of Boston. The bridge has a horizontal clearance between fenders of 175 feet. Vertical clearances of the span when closed are 20.7 feet at MHW, and 30.7 feet at MLW. No modifications to this span would be necessary under any of the deepening alternatives being considered.

The Chelsea Street Bridge crosses the channel about 1 mile upstream from the McArdle Bridge. Aerial photographs of this bridge are shown in Figure 16. Chelsea Street is a single leaf bascule Strause-Heel-Trunion Bridge completed in July 1937 and owned and operated by the city of Boston. The bridge has a permitted horizontal clearance between fenders of 96 feet. Damage to the fender system has resulted in an actual clearance of over 100 feet. Replacement of the fenders by the city is scheduled for the winter of 1988-89. The fenders and bridge are frequently struck by large tankers; the most recent major collosion involving over $600,000 in bridge repairs. Closed vertical clearances are 9.4 feet at MHW and 19 feet at MLW.

The city's planned fender replacement will afford a 96-foot horizontal opening with a better alignment to the actual vessel track. The Federal channel would be widened to the new fender opening at the 35-foot depth as an O&M project modification. The US Coast Guard's vessel beam limitation of 86 feet would then be reconsidered, and is expected to allow vessels of up to 90 feet, the former maximum, to once-again transit the bridge. The fender and channel width improvements and the use of 90-foot beam vessels will be considered as part of the without-project condition. This bridge and channel width limit vessel traffic in the Chelsea River Channel to one-way passage. As vessels now passing this bridge and those expected to use the terminals upstream after fender replacement both require greater depth, improvements to increase depth in


CHELSEA
EAST
BOSTON
CHARLESTOWN
North End
Sumner Tunnel
Callahan Tunnel
MBTA Blue Line Tunnel
LOGAN AIRPORT
N
BOSTON HARBOR, MASSACHUSETTS
FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT
FIGURE 14
LOCATION OF HARBOR TUNNELS
Proposed Third Harbor Vehicular Tunnel I-93
Proposed Depressed Central Artery I-93
Fan Piers
35-Foot Channel
40-Foot Channel
Massport Marine Terminal
RESERVED CHANNEL
CONLEY TERMINAL
SOUTH BOSTON
Pleasure Bay
NOTE: Solid Lines are Tunnels
Open Lines are Surface Roads
The Depressed Central Artery Tunnel will replace the existing elevated portion of I-93 with a Tunnel
SCALE: 1:25,000

VIEW TO NORTH - SEPTEMBER 17, 1985 - BY RICHARD DESIMONE

VIEW TO NORTH - SEPTEMBER 17, 1985 - BY MARK HABEL

BOSTON HARBOR, MASSACHUSETTS
FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT

FIGURE 15

McARDLE BRIDGE - CHELSEA RIVER
AERIAL PHOTOS

View to Northwest Toward Chelsea

View to Southwest Toward Chelsea

VIEW TO NORTH

NOTE: ALL PHOTOS TAKEN JUNE 8, 1987
BY NAEK HABEL, NED

BOSTON HARBOR, MASSACHUSETTS
FEASIBILITY REPORT
AIR ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT

FIGURE 16
CHELSEA STREET BRIDGE
AERIAL PHOTOS

the entire Chelsea River were examined. The existing horizontal clearance, while a constraint to navigational efficiency, does not preclude all benefits to deepening of the upstream reaches to depths of up to 40 feet. Cost estimates for replacement of this structure with a new bridge affording a clearance equal to that provided by the McArdle Bridge are roughly $25 million (NED-1987). Bridge replacement is considered to be uneconomic and was not carried futher as part of this study. The layout of the new fender system as presently envisioned is shown in figure 17A. A cross-section showing the new fenders and bridge piers and their relation to channel deepening is shown in Figure 17B.

Utilities

No utilities are known to cross the Reserved Channel in the area considered for improvement. Many submarine utilities, including cables, water tunnels, and siphons cross the Inner Confluence and the Mystic and Chelsea River Channels.

Several cables cross beneath the Mystic River Channel about midway up the deep-draft channel from the vicinity of the Blue Circle Atlantic Cement pier in Charlestown to the vicinity of the Prolerized Wharf in Everett. These cables are not expected to be impacted by the considered channel deepening.

Three submarine telephone cables cross the Inner Confluence from Charlestown to Chelsea immediately downstream of the Tobin Bridge at a depth of -50 feet MLW. These cables will not be affected by the proposed improvements.

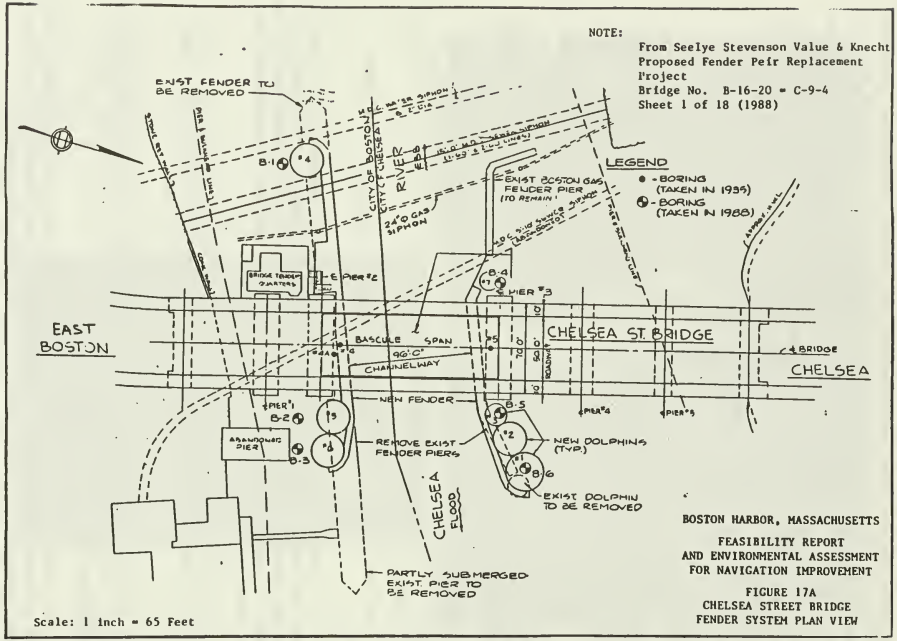
The Chelsea River is crossed by numerous utilities as described below:

a. A water supply tunnel crosses beneath the channel 1/10 of a mile below the McArdle Bridge. Top elevation of the tunnel is -38.5 feet on the East Boston Side and -39.6 feet on the Chelsea side. Deepening of the channel to depths beyond 38 feet would require lowering (replacement) of the tunnel at a cost of about $1,000,000.

b. Four power cables for the operation of the A.P. McArdle Bridge cross the channel between the fenders at a depth of -45 feet MLW. These cables will not be affected by the considered improvement.

c. Six New England Telephone Company cables and one City of Boston Fire Alarm cable cross the river about 1,800 feet upstream of the McArdle Bridge. With a top elevation of -45 feet these cables will not be impacted by the proposed deepening.

d. Sixteen five-inch electrical conduits cross the river about 2,800 feet upstream of the McArdle Bridge. With the top elevation of -50 feet these conduits will not be impacted by the proposed deepening.

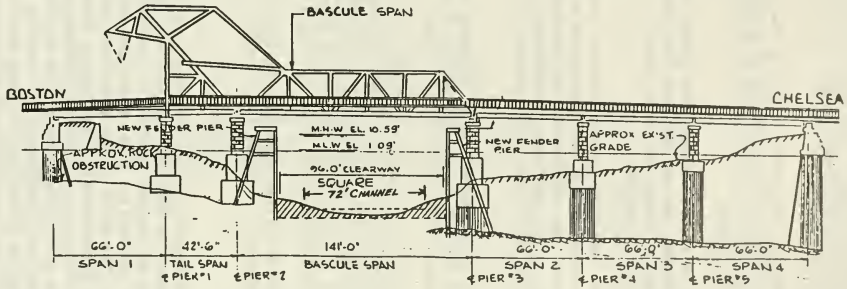

NOTE:
From Seelye Stevenson Value & Knecht
Proposed Fender Pelr Replacement
Project
Bridge No. B-16-20 = C-9-4
Sheet 1 of 18 (1988)
ENIST FENDER TO BE REMOVED
CITY OF BOSTON
CITY OF CHELSEA
RIVER
LEGEND
EXIST BOSTON GAS FENDER PIER (TO REMAIN)
- BORING (TAKEN IN 1939)
- BORING (TAKEN IN 1988)
24"O GAS SIPHON
BRIDGE TENDER QUARTERS
PIER #2
PIER #3
EAST BOSTON
BASCULE SPAN
99'-0"
CHANNELWAY
CHELSEA ST. BRIDGE
CHELSEA
NEW FENDER
PIER #1
PIER #4
PIER #5
ABANDONED PIER
REMOVE EXIST FENDER PIERS
NEW DOLPHINS (TYP.)
EXIST DOLPHIN TO BE REMOVED
CHELSEA FLOOD
PARTLY SUBMERGED EXIST PIER TO BE REMOVED
Scale: 1 inch = 65 Feet
BOSTON HARBOR, MASSACHUSETTS
FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT
FIGURE 17A
CHELSEA STREET BRIDGE
FENDER SYSTEM PLAN VIEW

Scale: 1 Inch = 50 Feet

NOTE: Compiled From:

1) Proposed Fender Peir Replacement Project
Seelye Stevenson Value & Knecht, 1988

2) City of Boston, Chelsea Street Bridge
Cenral Plan Sheet #1 July 1935
Drawing #6151



Material to be Removed for 38-foot Channel plus 2-Foot Overdepth

ELEVATION

BOSTON HARBOR, MASSACHUSETTS

FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT

FIGURE 17B
CHELSEA STREET BRIDGE
FENDER SYSTEM CROSS SECTION

e. The Massachusetts Water Resources Authority (MRWA) owns a 36 inch watermain crossing the channel at a depth of -45 feet about 315 feet downstream of the Chelsea Street Bridge. This main will not be impacted by the proposed improvements.

f. The MBTA owns two cables crossing the river about 300 feet downstream of the Chelsea Street Bridge at a depth of -40 feet MLW. The deepening being considered will require that these cables be lowered at an estimated cost of $40,000.

g. The Boston Edison Company owns three cables lying on the existing channel bottom between 200 and 300 feet downstream of the Chelsea Street Bridge. These cables would have to be buried as part of any channel deepening at a cost of $60,000.

h. The MWRA owns a 36-inch water pipe tunnel with a top elevation of -35.14 feet located about 190 feet downstream of the Chelsea Street Bridge. This tunnel has been unused for many years and would have to be abandoned as part of the proposed improvement. The section of tunnel beneath the channel would have to be removed to facilitate dredging, at a cost of about $30,000.

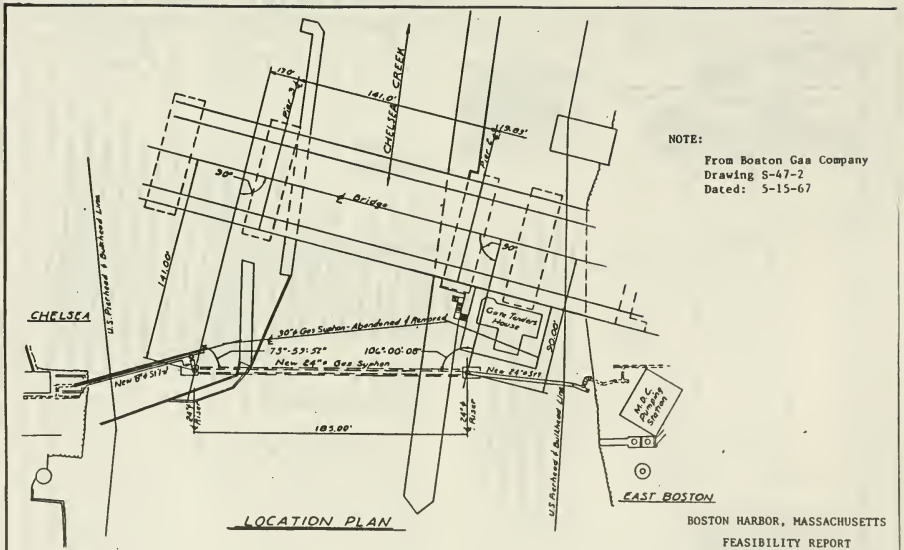
i. The MWRA owns a sewer siphon crossing the channel about 150 feet downstream of the Chelsea Street Bridge with a top elevation of -50.78 feet. The considered deepening will not affect this siphon.

j. The Boston Consolidated Gas Company owns a 24-inch gas siphon with a top elevation of -40.3 feet which crosses beneath the channel about 120 feet downstream of the Chelsea Street Bridge. Any incremental deepening beyond -38 feet would require replacement of this siphon with a lower crossing at a cost estimated at about $3,800,000. Detail of the existing gas siphon crossing is shown in Figure 17C.

The location of utility crossings in the vicinity of the Chelsea Street Bridge are shown in Figure 17D.

Landmasses

The existing harborlines, shorelines, and structures constrain channel improvements by limiting the available channel width and depth. This is a problem of special concern in restricted areas such as the Reserved Channel and Chelsea River where channel width is restricted to one-way traffic. The width of the Reserved Channel is approximately 600 feet bulkhead to bulkhead while the Chelsea River at some locations is limited to 300 feet in width. Channel deepening along the Reserved Channel deepening would require narrowing the channel so that the side slopes for the cut would not result in removing fill from the north bulkhead base thereby reffecting bulkhead stability. All effects of changes in channel configuration must be considered, and proper constraints identified to assure structural safety.


CHELSEA CREEK
Bridge
30°
141.00
CHELSEA
U.S. Pierhead & Bulkhead Line
30"ϕ Gas Siphon - Abandoned & Removed
73°-53'-52"
104.00'08"
New 24"ϕ Gas Siphon
New 24"ϕ Siphon
New 8"ϕ Siphon
Gate Tenders House
30.00'
183.00'
24"ϕ Riser
M.D.C. Pumping Station
EAST BOSTON
LOCATION PLAN
NOTE:
From Boston Gas Company
Drawing S-47-2
Dated: 5-15-67
BOSTON HARBOR, MASSACHUSETTS
FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT
FIGURE 17C
CHELSEA STREET BRIDGE
GAS SIPHON PLAN
Scale: 1 Inch = 60 Feet

UTILITY CROSSINGS – CHELSEA STREET BRIDGE AREA

FIGURE 17D

Institutional Constraints

Two types of institutional planning constraints for the Boston Harbor Navigation Project are legislative constraints, and harbor management constraints.

The legislative constraints would be most applicable to the environmental aspects of the project, and involve limits on dredging operations and disposal of the dredged material, considered to be a major environmental constraint. There is only one approved interim disposal site, the Foul Area, for disposal of dredged materials at this time. This does not preclude the development of other disposal sites, but will be considered a constraint for purposes of this study. Additional coordination with State and Federal regulatory agencies would be required to identify approved alternative disposal sites. Results of coordination efforts to date are contained in the Environmental Assessment.

Dredging may temporarily disrupt the water quality on a short term basis, and blasting may affect sea life in the immediate area. However, scheduling of both of these channel improvement activities may be affected by migration of marine animals and fluctuations in harbor traffic, which will dictate when work can be performed. The legislative constraints most likely will be dictated by the various State and Federal agencies which regulate work impacting upon the environment, as authorized by State and Federal policies, laws and regulations.

No harbor management planning constraints are anticipated during the construction of the proposed improvements. However, implementation of non-structrual measures may cause constraints and changes in the management of the harbor. For example, a traffic control system is possible, but there may be concern over the ability of harbor authorities to manage a complex system and no local agency has been given such authority at this time. Use of offshore terminals, etc., would require additional resources to monitor activities over a larger area. With a structural solution the management of the harbor should be facilitated by the improvement and existing practices, because of safer and easier shipping movements. Plans of other agencies involved with Boston Harbor appear to be consistent with the currently proposed channel improvements, so no constraints or other concerns are anticipated in this respect.

Economic Constraints

There are no known major economic constraints in the implementation of the proposed improvements. There may be a concern over the timeframe for funding, however this factor is unknown at this time. A local concern which may impact the local contribution is the provision of land and building of dikes, should a land disposal alternative or containment site option be implemented. This cost would be absorbed by local interests.

All of the above mentioned constraints were given consideration during the plan formulation process when pertinent. Specific constraints are mentioned later in this report with details of their effects on specific alternatives during formulation and evaluation.

PLANNING OBJECTIVES

To properly address identified problems of the study area, specific planning objectives were established. Planning objectives are a group of basic statements thst identify the overall goals to be achieved through implementation of a project. In conjunction with the identified problems, opportunties and planning constraints, the planning objectives provide a general framework for the formulation of alternative plans. The planning objectives were determined by addressing known areas of public concern and by anticipating future problems not readily apparent to the public at the present time. Planning objectives also provide a means of assisting in the evaluation of alternative plans, by determining to what degree planning objectives have been met. The following planning objectives have been established for the Boston Harbor Navigation Study.

1. Improve the accessibility and maneuverability for commercial navigation in Boston Harbor during the 1995-2045 period of analysis.

2. Improve the safety of navigation for commercial vessels transiting Boston Harbor during the 1995-2045 period of analysis.

3. Contribute to a reduction in transportation costs for waterborne commerce in Boston Harbor during the 1995-2045 period of analysis.

4. Contribute to the efficient use of existing and future port facilities in conjunction with the socio-economic needs and future desires of all local interests during the 1995-2045 period of analysis.

5. Contribute to the environmental quality of the Boston Harbor estuary by reducing the probability of adverse environmental events caused by implementation of an improvement project during the 1995-2045 period of analysis.

PLAN FORMULATION

This section of the report describes the planning process involved in the formulation of alternative plans. The plan formulation rationale describes the sequence and methodology that was utilized in the development of alternative plans leading to selection of a plan of improvement. Possible management measures available to pursue the plan of improvement are also identified. Initial screening of the formulated alternatives was performed in order to determine whether an alternative would be carried forward for more detailed evaluation. This screening process yielded the final array of detailed plans to be assessed and evaluated.

Plan Formulation Rationale

In order to formulate plans that best address the identified problems, planning constraints and established planning objectives, a logical sequence of planning steps was taken. The following sequence of planning steps provides a general outline of the formulation process.

1. The initial step was to identify plans being proposed, or under construction by local interests. These plans were examined to determine if they would have any impact on a navigation improvement project.

2. Possible management measures, both structural and nonstructural, were identified and evaluated to determine their feasibility for implementation.

3. Alternative plans were formulated utilizing the management measures identified for further consideration. Preliminary screening was performed by incrementally analyzing various structural and nonstructural portions of the potential plans.

4. Increments that survived the preliminary screening were combined to form overall plans for detailed analysis and evaluation. Performance of detailed comparative evaluation yielded a selected plan.

Plans of Others

A survey of plans being considered by local interests for potential implementation in the study area was made. Two local plans were identified as having a direct impact on a potential navigation project. These plans include the construction of a vehicular tunnel under the Main Ship Channel, and the construction of a general cargo terminal facility adjacent to the Main Ship Channel in South Boston.

The Massachusetts Department of Public Works, the Massachusetts Executive Office of Transportation and Construction, and the Massachusetts Turnpike Authority are proposing plans for construction of a third vehicular tunnel connecting Boston and East Boston. The preferred alternative route under the Main Ship Channel is shown on Figure 14. Coordination

between Corps of Engineers and the Commonwealth of Massachusetts and their consultants has been maintained to insure compatibility of the tunnel plan and a potential navigation improvement project.

The Massachusetts Port Authority initiated construction of an additional general cargo facility in 1981. It is located at the Harbor Gateway Terminal formerly known as the South Boston Naval Annex, in South Boston. The facility is being built on 37 acres of filled in water area and 10 acres of adjacent land along the Main Ship Channel. Filling, paving and berthings were completed in 1986 and the facility is now in use for receiving automobiles. The new facility has increased the usable cargo space for the port by about 30 percent. Aerial photos of this facility are provided in Appendix 1 as Figure 1-22.

Several other local plans under consideration, or being proposed include construction of a fixed span bridge to replace the existing Northern Avenue bridge across the Fort Point Channel (Part of the Third Harbor Tunnel project), the city of Boston's plans for reconstruction of the Chelsea Street Bridge Fenders, a Massport plan to develop an air cargo facility on the filled Bird Island Flats area at Logan Airport, and other waterfront recreation and business development. These plans would have minimal impact on a navigation project, except that an additional air-ocean shipping terminal could be established. This potential feature of the Massport plan has not been proposed as yet. The proximity of the Third Harbor Tunnel to the deep draft Reserve and Main Ship Channels at one end and the airport on the other end presents similar attractive and significant possibilities.

Management Measures

A broad range of management measures, were evaluated to determine which would best address the existing navigation problems. Both nonstructural and structural measures were considered in the formulation of alternative plans. Nonstructural measures are those measures that can be implemented without performing major construction to modify the existing navigation system. Structural measures include construction of major modifications to the existing navigation system. The following management measures were considered for improving navigation in Boston Harbor.

1. Tidal navigation
2. Navigation aids
3. One-way traffic and traffic control
4. Lightering
5. Alternative Port Utilization
6. Pipelines and Offshore Terminals

7. Inner Harbor Pipelines and Terminals

8. Channel and Anchorage Modifications

Management Measures Evaluated

Tidal Navigation

Tidal navigation is the use of the tide to assist a deep draft vessel transitting a shipping channel. Navigation channels are generally dredged to a depth based on the mean low water datum (MLW). This depth tells the vessel operators that a vessel of certain draft can transit a channel safely at mean low tide, taking into account the necessary clearances. In order to utilize tidal assistance, a deep draft vessel must wait for a higher tide to move into the harbor.

Tidal assistance is used extensively in both the entrance channel at Broad Sound and to a greater extent in the Inner Harbor channels. The entrance channel is at a depth of -40 feet MLW and the inbound lane of the Main Ship Channel, the Reserved Channel, the Inner Confluence Area, the Mystic River Channel and the Chelsea River Channel are all at a depth of -35 feet MLW. Utilizing the present underkeel requirements of the harbor pilots which allow somewhat more flexible use than published channel design criteria, all of the above channels permit a vessel with a maximum draft of 32 feet or less to navigate them at MLW. Although the Broad Sound North Channel is 5 feet deeper than Inner Harbor channels, some extra depth is required for clearance due to pitch, roll and yaw effects in this unprotected channel. The Inner Harbor channels are sheltered and harbor pilots require only 3 feet for normal clearance, trim, vessel motion and squat effects, while 5 feet underkeel is normally required in the entrance channels.

In 1985 there were 282 recorded vessel trips of vessels with drafts of 32 feet or greater. These vessels were required to wait and utilize tidal assistance, since the maximum allowable draft at mean low water for the tributary channels is 32 feet. Of the 282 vessel trips, almost all were inbound tanker trips. This group of largest tankers moved approximately 15 million tons of petroleum product. The 15 million tons of petroleum products represents 66 percent of total petroleum products and 57 percent of total commodities that were moved through the Port of Boston. This percentage of petroleum products, plus the percentage of cargo carried by the other deep draft vessel trips, indicated that well over half the cargo moved through Boston Harbor utilized tidal assistance.

The present tidal delay in Boston Harbor ranges up to five hours. As larger ships come into service the number of tidal delays and the length of the delays will increase, thereby increasing economic inefficiencies. Greater use of smaller vessels, which is contingent upon their availability, would also increase costs of handling. Additional use of tidal assistance would further restrict movement in the harbor as many vessels would attempt to simultaneously utilize tidal assistance.

Tidal navigation can be incorporated into plans which include structural modifications. At any particular depth, smaller vessels will be afforded full tidal access while larger classes of vessels must move with tidal assistance. This is the present situation in Boston. Channel depths can be evaluated based on tidal access for the largest class of vessel which terminal operators expect to use given their existing demand and storage limitations.

Tides at Boston Harbor are semidiurnal, occurring approximately twice a day. The annual average tidal range is about 9.0 feet at the harbor entrance and 9.4 feet in the Inner Harbor. Tidal range varies widely from day to day and the two tides within anyone day will also differ in range. Consecutive tides may differ in range by as much as 2.0 feet. The maximum range is 13.8 feet and the minimum range is 5.5 feet. Tidal ranges generally cycle twice monthly with alternating high and low maximums and high and low minimums. The average monthly low minimum range is about 6.1 feet. Low tide levels may vary by as much as 4.0 feet in a month, the average monthly variance being 3.5 feet. Annual lowest low water (LLW) is -2.2 feet, while the average monthly LLW is -1.8 feet. The average monthly maximum tidal range if 13.2 feet. High tide levels vary by as much as 4.1 feet, the average monthly variance being 3.6 feet. Annual highest high water (HHW) is 11.7 feet, while the average monthly HHW is 11.4 feet. The following Table details the monthly high and low water levels and tidal ranges for the inner harbor.

Highest low water (HLW) and lowest High Water (LHW) typically coincide with minimum tidal range, while LLW and HHW coincide with maximum tidal range.

TABLE 14
BOSTON HARBOR, MASSACHUSETTS
TIDE LEVEL VARIATIONS
INNER HARBOR

	TIDAL RANGE		HIGH WATER LEVEL		LOW WATER LEVEL	
	MIN.	MAX.	HIGHEST	LOWEST	LOWEST	HIGHEST
JANUARY	6.5	13.8	11.6	7.8	-2.2	1.3
FEBRUARY	5.8	13.8	11.6	7.5	-2.2	1.7
MARCH	5.5	13.4	11.4	7.5	-2.0	2.0
APRIL	5.7	13.3	11.4	7.7	-1.9	2.0
MAY	6.2	12.5	11.1	8.1	-1.4	1.9
JUNE	6.6	12.4	11.1	8.0	-1.3	1.6
JULY	6.3	13.3	11.5	7.8	-1.8	1.5
AUGUST	6.1	13.3	11.5	7.7	-1.8	1.6
SEPTEMBER	6.1	13.6	11.6	7.8	-2.0	1.7
OCTOBER	6.1	13.7	11.7	7.9	-2.0	1.8
NOVEMBER	6.1	13.1	11.4	8.0	-1.7	1.9
DECEMBER	6.5	12.0	10.8	8.2	-1.2	1.7
AVERAGE	6.1	13.2	11.4	7.8	-1.8	1.7
ANNUAL EXTREME	5.5	13.8	11.7	7.5	-2.2	2.0

NOTE: All elevations referenced to Mean Low Water (0.0)
Source NOAA 1988 Tide Tables for Boston, MA. Entrance channel water level values will be 0.2 feet lower at high water and 0.2 feet higher at low water due to the 9.0-foot average tidal range vs. 9.4 feet in the Inner Harbor.

The high variability in tidal fluctuations at Boston Harbor results in a variety of navigational inefficiencies. At the average Inner Harbor 9.4-foot range the tide will rise or fall at a rate of about 1.6 feet per hour, 1.0 and 2.3 FPH for the extreme minimum and maximum ranges. Some shippers choose to risk tidal navigation under these circumstances. In 1986, 4 vessels loaded to a draft of 41 feet attempted to transit the harbor when their schedule coincided with monthly HHW levels in daylight. Three were successful in reaching their berths. According to the Boston Pilots, the fourth vessel's master refused to allow his vessel past the anchorage due to the rapidly falling tide and left the harbor to lighter at Philadelphia before returning to Boston at a lesser draft.

Most shippers, for whom scheduling is of prime importance use light loaded or smaller vessels. The Atlantic Class containerships, which make weekly trips, arrive at Boston on Tuesdays, and in order to keep to schedule must be able to transit and berth regardless of the water level. Most shippers go halfway, loading for tidal navigation and incurring some delays but only counting on the lowest highwater level and minimum tidal range so as to minimize that delay and assure access on any given day.

Large vessels using tidal navigation begin their harbor transit 1.5 to 2.0 hours before high water in order to begin onloading by 0.5 to 1.0 hours after high water. This schedule is necessary due to the need to maintain at least 3 feet underkeel in the 35-foot inner channels. The Boston Pilots currently will limit their guaranty of safe passage to vessels drafting no greater than 39' 6". The pilots also state that typical underkeel requirements are 5 feet in the entrance channel and 3 feet in the Inner Harbor. Table 15 details the mechanics of tidal navigation under existing practices. A 35-foot inner channel plus 7.8 feet LHW in the Inner Harbor minus 3.0 feet for underkeel clearance and 0.5 to 1.0 feet of falling tide would allow a maximum draft of about 39 feet. The pilots are assuming some risk here by allowing loading of an extra 6 inches. The current maximum draft capable of transiting the entrance channel without accounting for inner harbor restrictions is 42 feet entering at LHW within 0.5 hours of the top of tide (40' channel + 7.6' LHW - 0.5' tide = 42' boat + 5' underkeel).

Deepening inner channels to -38 feet would allow drafts of up to 42 feet to transit the harbor safely at MHW. Deepening an additional 2 feet to -40 feet, would allow these vessels to transit both the entrance channel and inner harbor on any high tide day by shifting the beginning of their transit to near the high water level. Both shippers and pilots have stated that it is this final savings, the ability to effect safe tidal navigation at the 41-42 foot range regardless of a particular day's high water which will induce the use of larger vessels.

TABLE 15
BOSTON HARBOR, MASS
TIDAL NAVIGATION
EXISTING PRACTICE-WITHOUT PROJECT

	ENTRANCE CHANNEL	INNER CHANNEL
Vessel Draft	39.5	39.5
Underkeel	5.0	3.0
1) Water Required	44.5	42.5
Channel Depth	40.0	35.0
LHW	7.6	7.8
Tide Correction		
Range	5.7	6.1
Per Hour	0.9	1.0
Hours	2.0	0.5
Correction	-1.8	-0.5
2) Water Available	45.8	42.3

Making full use of the entrance channel's existing depth of 40 feet MLW while adhering to the LHW scheduling concerns of the shippers and the 42-foot 80,000 DWT Design Vessel would require an additional 5 feet of depth in the inner harbor's 35-foot tributary channels as shown in Figure 16. A 42-foot vessel needing 5 feet underkeel (total -47 feet) would have no difficulty transitting the entrance channel within 0.5 hours of LHW when 7.6 feet of tide is available in the 40-foot channel (40.0 channel + 7.6 LHW - 0.5' below top of tide total 47.1 feet).

After a 2.0 hour transit to berth in the Inner Harbor the 42 foot vessel would need 3 feet underkeel (total 45 feet). The Inner Harbor's 7.8-foot LHW would be reduced by 2.0 feet after a 2.0 hour drop on a 6.1-foot tidal range.

The 42-foot vessel needing 45 feet of water in the inner harbor channels (3 feet underkeel) riding 5.8 feet of tide (7.8 feet LHW minus 2.0 feet of tide) would therefore require a 40-foot channel (45-5.8 = 40.8). In order for this vessel to safely transit the harbor, the existing practice of starting the transit 1.5 hours before high water would be shifted to starting at highwater, plus or minus 0.5 hours. An average delay of about 2.5 hours could be expected, one-half of a 6-hour tide minus 0.5 hours.

Conditions of reduced visibility, stronger than average headwinds, delays in meeting and tying-along tugs, etc. will all contribute to some variability in tidal navigation practices. Vessel transit times and the time of commencing transit would all be adjusted on a day-to-day and case-by-case basis by individual pilots.

TABLE 16
BOSTON HARBOR, MASS
TIDAL NAVIGATION
WITH PROJECT CONDITION

	ENTRANCE CHANNEL	INNER CHANNEL
Vessel Draft	42.0	42.0
Underkeel	5.0	3.0
1) Water required	47.0	45.0
Channel Depth	40.0	35.0
LHW	7.6*	7.8
Tide Correction		
range	5.7	6.1
per hour	0.9	1.0
hours	0.5	2.0
correction	-0.5	-2.0
2) Water Available	47.1	40.8
Additional depth required to make 2 > 1	none	5 feet

* At LHW underkeel needs and limited high water level require a vessel to begin transit 0.5 hours to high tide.

Navigation Aids

A navigation aid system is used to provide guidance to vessel operators for navigating a harbor. They usually consist of a variety of buoys used to mark channels, and hazardous areas, lights and lighthouses for night navigation, and shore markers to indicate areas that project into waterways.

The navigation aids presently used in Boston Harbor are generally adequate for the safe movement of vessels. One possibility that has been identified is to mark the split depths of the Broad Sound North Entrance Channel and the Inner Harbor Main Ship Channel. The existing channels currently are 35 feet for incoming vessels and 40 feet for outgoing vessels. Most of the activity in Boston Harbor is importation, therefore the bulk of fully loaded vessels are incoming. These vessels tend to skirt the channel centerline to utilize the depth of the outgoing lane. It is anticipated that this type of activity will continue, and placement of channel centerline markers would prove to be more of a navigation hazard than a help. The many turns in the Main Ship Channel would make extensive usage of range markers impractical. Range markers for some of the longer reaches, particularly in the entrance channels, would be practical, however this would not solve the problems relating to the Main Ship Channel.

Use of navigation aids alone will not meet the needs identified for this study. Therefore, the use of navigation aids alone was eliminated from further consideration. Review of navigation aids requirements usually occurs whenever a modification to a harbor configuration is made, and generally it becomes an integral part of the harbor management plan.

One-Way Traffic and Traffic Control

Current traffic volumes in Boston Harbor make one-way traffic workable, since only two to four arrivals of large vessels occur daily. Since significant increases in traffic volumes are not projected to occur, a traffic control system to manage and direct one-way traffic is not considered necessary. larger vessels now utilize the deeper of the split-depth channel lanes in the Broad Sound North Entrance Channel and Main Ship Channel without regard to the "rules of the road", leaving the large volume of small craft traffic to use the other areas of the full channel widths.

Lightering

Lightering involves the transfer of cargo in deep water from a larger vessel to a smaller vessel, and then moving the cargo through the harbor to the appropriate offloading point via the smaller vessel. The larger vessel can be completely unloaded onto smaller vessels, or it can be partially unloaded to a point where it can safely transit shallower harbor channels. This allows vessels to deliver a full load of products to the

port. At the present time Boston Harbor is not involved in extensive lightering. According to the Boston Pilots, only five percent of the traffic currently lighters. Lightering usually occurs in the President Roads Anchorage area. The pilots indicated that the anchorage area is presently not deep enough to facilitate lightering of larger tankers.

Lightering of tankers is the most popular form of lightering, since it is not too complicated to perform. Lightering of bulk cargo and containerships would be quite difficult since large overhead cranes are necessary to transfer the cargoes. One concept that has been developed to get around bulk cargo lightering difficulties is the use of a LASH (Lighter Aboard Ship) system. This system utilizes self contained barges which are prepacked onshore and then floated out into the harbor to be picked up by specialized LASH vessels. Other barges are dropped off by the vessel to be returned to shore for unloading. The LASH system, however, is not extensively used in the United States at the present time and is rarely used in Boston Harbor.

The area outside of Boston Harbor, Broad Sound, has a wave climate that is undesirable for lightering as the area is open to long trans-Atlantic fetches which produce heavy swells. This area can be eliminated for lightering operations, except during occasional calm conditions, which would at best be highly unpredictable. Another negative factor is that lightering from Broad Sound is approximately 10 miles from the most upstream user.

Lightering could only occur in conjunction with structural improvements in both the Broad Sound Entrance Channel and the President Roads Anchorage, since both of these features have insufficient depth through a tidal cycle to accommodate the larger ships to be lightered. Therefore, increased lightering as a feasible management measure could only be implemented in conjunction with entrance channel and anchorage deepening.

Lightering also poses problems from an environmental viewpoint. During even the most carefully monitored lightering operations minor spills of petroleum products can occur. Considering the massive effort being presently undertaken to improve the environmental quality of Boston Harbor, it is unlikely that an increase in lightering operations would not be consistent with environmental quality initiatives being persued by other agencies.

Alternate Port Utilization

The possibility of utilizing other ports and trucking cargo appears to be remote. Boston Harbor is the largest and most well established port in New England and is centrally located to the market area. It is the commodity distribution point for the immediate metropolitan Boston area, most of eastern Massachusetts, and much of southern New Hampshire which contains most of the development of that state. A multiport analysis was not conducted since there were no indications present in the course of

discussions with terminal operators that commodity flows to competing port hinterlands would shift to any significant extent if Boston Harbor were to be deepened five feet or less.

The nearest ports that might be considered are New Haven, Connecticut; Providence, Rhode Island; Portsmouth, New Hampshire; and Portland, Maine. Channels in these ports, except Providence, are only 35 feet deep at present, and would thus require channel improvements to handle the larger vessels. Providence Harbor was provided with a 40-foot depth in 1967, however, local development to utilize this depth has never occurred and is not expected to occur. Providence is less centrally located to the Boston Market area and overland transportation costs would likely exceed the inefficiencies experienced or projected for Boston. New Haven Harbor is presently being studied to determine its adequacy as the major Connecticut port, let alone the addition of a percentage of cargo destined for the Boston area. Provision for the deepening of New Haven Harbor to -40 feet was made in the WRDA of 1986 and studies required by that Act prior to final design preparation are ongoing. Channel widening at Portsmouth Harbor was authorized in 1986 and plans and specifications for that project are being prepared, however, no deepening is planned. Portland is a possibility, but as Maine's major port, extensive expansion would be required. A 1987 Feasibility Report concluded that no deepening of Portland Harbor, beyond the 35 feet now provided, was required. In addition these ports would require massive capital investments to provide storage and facilities for transfer of cargo to the Boston metropolitan area. It must be noted that each of New Englands major ports serves its own market area with only very slight overlap of hinterlands.

Because of Boston Harbor's established position as a harbor, possibility of major disruption of the regional economy and cost of capital investment for new additional facilities, this management measure has been eliminated from further consideration.

Pipelines

The idea of shipping oil in by pipeline was considered but eliminated from further evaluation as an alternative solution at Boston Harbor. Although proven as an efficient means of transporting oil products, it was not found to be practical for Boston. The Continental Pipeline, which extends from the Gulf Coast to New York, is used currently for the bulk transfer of petroleum commodities, principally gasoline. However, provision for spare capacity and extension of the line into New England is not contemplated to handle the products presently transported into the Port of Boston by tanker vessels. In view of environmental considerations and the increasing cost of pipeline construction, additional pipelines emanating from the Gulf Coast servicing New England are not contemplated for the foreseeable future. Possible utilization of a pipeline from New Jersey, where petroleum refineries are located, could be considered for transporting gasoline to the Boston area. This pipeline would cover a distance of approximately 225 miles which at a cost of about $1,000,000

per mile (1981 estimate) would result in a construction cost of about 225 million dollars. The private sector has not shown interest in such a venture, and is satisfied with the present supply system.

The major petroleum product shipped into Boston currently is distillate oil, and most of it is shipped from foreign sources in foreign bottoms. As an example, in 1986, 34 percent of the petroleum products tonnage shipped into Boston Harbor was distillate, and 53 percent of this was brought in by foreign vessels. Further, 73 percent of residual fuel, which constituted 26 percent of total petroleum shipments, was also brought in by foreign vessels. In the New England area, approximately 84 percent of the oil used originates in the Middle East. Therefore the use of a domestic pipeline would not alleviate the need for Boston Harbor to handle deep draft foreign flag vessels, and consequently, pipelines are not considered an adequate alternative.

Offshore Unloading Terminals

Offshore terminals for the transfer of petroleum products to shore would at first glance appear to be a desirable measure in meeting the energy needs of the area. Although the coast of New England is susceptible to rough seas, including those caused by northeasters, it is feasible from an engineering viewpoint to construct offshore terminals. Construction of drilling platforms that have withstood severe storms around the world provide evidence for possible construction of offshore terminals in New England waters.

Nearly 50 percent of deep-draft vessel traffic in Boston Harbor is tanker traffic, which are the largest vessels which use the harbor. If tanker traffic could be diverted to offshore terminals the harbor would be adequate for the smaller bulk cargo vessels for sometime, thus not requiring channel modifications at this time. However, vessel sizes for bulk cargo and container ships are increasing and would eventually require channel modifications.

Land storage capacity of the current petroleum infrastructure in Boston is near the maximum at this time. Therefore additional storage capacity is not required to maintain a proper supply level at this time. There is, however, minimal space remaining for construction of additional storage area, so that other areas must be developed for storage or the time period of supply will decrease. As demand rises the supply will decrease when utilizing existing storage capacity.

Currently there are no plans for development of offshore petroleum terminals. A major factor which the oil companies attribute to lack of development of offshore terminals, is strong environmental opposition to such activities in New England waters. The Commonwealth of Massachusetts, Congressional interests and numerous private groups have been vehement in their opposition to the proposed Outer Contintental Shelf (OCS) leases in the offshore waters of New England. Therefore the oil companies presently

find it too costly, time consuming and frustrating to take on the strong environmental opposition, to warrant offshore terminal development in New England. Implementation of this management measure appears highly unlikely and has therefore been eliminated from further consideration.

Inner Harbor Area Pipelines and Terminals

Construction of inner harbor area pipelines and new offloading facilities as an alternative to dredging one or more tributary channels was also examined. For the Reserved Channel such a scheme was ruled out due to the lack of an available site. All available land along the Main Ship Channel within a cost-effective distance is presently taken up by existing terminals. Castle Island, the only undeveloped site, is not only a National Historic Site, but also lies immediately across the Main Ship Channel from the end of one of Logan International Airports two principal runways. Landing aircraft pass directly over the island while noisier departing aircraft varry their routes turning southeast between Castle and Spectacle Islands so that noise levels over South Boston neighborhoods will be abated.

The use of the Inner Confluence and adjoining areas along the 40-foot Main Ship Channel was examined for a pipeline terminal servicing either the Mystic or Chelsea River terminals. No undeveloped shorefrontage is available in this area. Construction of shoreside facilities, access and the pipeline itself would require the taking and displacement of existing residential and commercial properties. Terminal and berthing placement in this area would also restrict the access of non-petroleum bulk carriers to their facilities on the two river channels, or costly removal of extensive ledge areas, as rock was encountered in the areas adjacent to the 40-foot channel during construction of the 35-foot channel.

The provision of a terminal and pipeline to serve the 5 Chelsea River terminals upstream of the Chelsea Street Bridge was also examined. Such a facility would be an alternative to dredging above Chelsea Street. Two locations were considered, along the East Boston Shore of the lower Chelsea above the Amarada Hess Terminal and in East Boston Harbor north of the airport. Both sites would involve similar costly taking and displacement impacts on properties. The lower Chelsea site would also involve extensive intertidal dredging and wetlands alterations. The East Boston Harbor site is unacceptable due to its location off of a public beach and being less than 1000 feet off the end of one of the airports two principal runways.

Location of a terminal along the downstream end of the Mystic River Channel upstream of the Tobin Bridge would result in displacement of a municipal marina and require extensive ledge removal. This area was originally included in the 35-foot project of 1958, but the extent of the ledge encountered resulted in a modification to the project to provide a narrower channel. It is only a short pipeline or dredging distance from here to the Exxon terminal in any case, and any pipeline would include a

drop beneath the Island End River's 23-foot commercial channel. Such a terminal would not serve the Prolerized Scrap Terminal or the Distrigas LNG Terminal.

Neither the terminals in question or the project sponsor have any interest in undertaking the construction and operation of any unloading terminal-pipeline system.

Channel Improvements

The final management measure evaluated entails improvement of the navigation channels. Improvement of navigation channels usually consists of deepening, widening and realignment of navigation channels. Improvement of Boston Harbor channels would require extensive dredging and blasting in ledge areas. Channel improvements would allow existing classes of vessels to more efficiently utilize Boston Harbor. Shipping interests could also bring in larger ships with tidal assistance, and realize savings in transportation costs, which could be passed on to the consumer. Improvement of the channels would be consistent with local plans for development. Boston Harbor developers are currently in the process of expanding harbor facilities, primarily container facilities, which will cause an increase in vessel traffic. Improved channels would assist in facilitating future plans for the harbor.

A plan involving channel improvements would be able to meet the goals and objectives for this study, so this management measure has been retained for further consideration. Such improvements will be evaluated in concert with tidal navigation opportunities in order to optimize efficiency.

Management Measures Recommended

Of the management measures previously evaluated pipelines and Alternate Port Utilization were determined to be insufficient to meet the market's demand. Inner Harbor Pipelines were determined to be impractical and institutionally nonimplementable. Offshore Terminal Construction and increased lightering were determined to be improbable from a regulatory and environmental viewpoint. The numerous existing navigational aids are sufficient to accommodate the with and without-project conditions. The one-way traffic pattern for deeper draft vessels in the Inner Harbor is not expected to change.

Channel improvements and tidal navigation were considered for incorporation into detailed plan formulation. Tidal navigation, a present practice, could be eliminated for existing vessel classes and larger vessels brought in with tidal navigation should channels be deepened. Minor modifications to channel alignment through President Roads could be made by repositioning navigation buoys in this reach during their next scheduled maintenance. This would increase the available deep water area of the anchorage.

Formulation of Alternative Improvements

This section presents the range of alternatives considered in the formulation of detailed plans. All of the harbor's deep-draft navigation features were considered and screened for inclusion in detailed plans. Some features were found adequate for existing and projected needs, such as the 27 and 30-foot entrance channels, and were not carried forward. A nonstructural alternative was identified which would improve the existing navigation system by delineating Federal channel limits between the confluence of the entrance channels and the Main Ship Channel, effectively enlarging the President Roads Anchorage in deep water at no cost. Structural modifications to the entrance channel system, Main Ship Channel and tributaries were evaluated and carried forward for detailed analysis.

Incremental Alternatives

This section of the report considered incremental alternatives for various segments of the existing channels and turning areas to permit navigability into President Roads and the Inner Harbor from the Broad Sound region. As previously described, there are currently three major access channels from Massachusetts Bay into President Roads all joining at the outer confluence, as shown in Figure 18. Two of these entrance channels, the 27-foot Narrows Channel and the 30-foot Broad Sound South Channel are not considered further. This study is concerned with the 40-foot Broad Sound North Entrance Channel.

Broad Sound North Entrance Channel

The segment of existing channel which is 40 feet deep and 1,100 feet wide from Broad Sound to Finns Ledge provided the major deep water access into Boston Harbor from the open sea. At Finns Ledge the channel turns 26 degrees (left when inbound), and the 40-foot depth narrows in width to 900 feet. A 35-foot deep channel with a width of 600 feet is provided to the northwest of the 40-foot channel beginning at Finns Ledge. The channel limits for both lanes end in deep water at the Outer Confluence Area located off the Deer Island Light in President Roads. Alternative improvements considered for the Broad Sound North Entrance Channel would provide for:

1) In consideration of widening of the 40-foot deep channel beyond its 900 and 1,100-foot widths, it was concluded that the existing width is adequate for current needs. Widening at the bend to provide a cutoff to improve turning safety could be considered although such an improvement would have an insignificant effect on navigational efficiency.

2) Removal of the southeast portion of Finns Ledge to provide a straight channel alignment from the open sea to the Outer Confluence. In consideration of removal of Finns Ledge and in coordination with the U.S. Coast Guard and the Boston Harbor

Pilots Association, it was reported that this ledge should be removed for safety reasons, however, the high cost involved in such an improvement makes this an unlikely alternative. The existing condition at this turn was not demonstrated to impose a significant safety risk or impediment to efficient navigation. Modifications were determined to be uneconomic.

3) Deepening of the existing entrance channel beyond its 40-foot existing depth was considered. Incremental depths considered were 43,45,47 and 50 feet. It was concluded that deepening is not necessary to satisfy the needs of existing or projected vessel traffic.

President Roads Anchorage

The existing anchorage provides about 350 acres at a depth of -40 feet MLW. The Main Ship Channel is an undefined area along the anchorage's southern limit. Deepening or enlarging this anchorage was jointly considered with improvements to the Broad Sound North Entrance Channel. Currently vessels up to 45,000 DWT utilize the harbor, but with tidal assistance. Deepening beyond 40 feet would allow use by vessels up to 80,000 DWT. Deepening the Broad Sound North Entrance Channel and a portion of the anchorage would allow lightering of larger vessels in the Outer Harbor without the need to deepen areas of the Inner Harbor beyond 40 feet. Although incremental depths were considered for the President Roads Anchorage, changes to the deep draft needs in the mid 1980's indicate that existing anchorage depths are adequate for the foreseeable future. This determination would be strengthened by adoption of the non-structural alternative to declare specific Federal Channel limits through the Roads, thus enlarging the anchorage by about 70 acres or 20 percent, in waters generally 43 feet deep or greater.

Main Ship Channel

The existing Main Ship Channel, from President Roads to the Inner Confluence, has depths of 40 and 35 feet, and is divided into three reaches as follows:

Reach 1) The President Roads to Reserved Channel reach currently provides a right, or inbound lane, 35 feet deep by 600 feet wide. The south, or outbound lane, is 40 feet deep by 600 feet wide.

Reach 2) The reach from the Reserved Channel to the Fort Point/East Boston Piers area has the same dimensions as the first reach However, beyond the Boston Fish Pier on the south and the East Boston Piers on the north the 40-foot depth of channel widens to 1200 feet for a distance of about 1,800 feet.

Reach 3) The reach from the Fort Point Channel to the Inner Confluence provides a 40-foot depth of varying width, and 35-foot deep paralleled channels along the downtown Boston, Charlestown, and western or upper East Boston waterfronts.

Alternative improvements for the Main Ship Channel consist of widening the 40-foot deep portion, either at critical bends only or along its full length, and deepening the existing or widened portion beyond 40 feet. Incremental distances over which these improvements would be made are; Reach 1 only, Reaches 1 and 2, or Reaches 1, 2, and 3 as depicted in Figure 19.

Widening and or deepening of Reach #1 would facilitate the transit of deeper draft traffic from President Roads to the Reserved Channel and dry dock area. Improvements considered for Reach #1 would also include channel bend widening by providing cutoffs at the Spectacle Island Turn and Lower Middle Shoal Turn. Widening and or deepening beyond in Reach #2 to the Fort Point Channel area would also serve deeper draft traffic using the Massport Marine Terminal and the deep-water East Boston Piers recently purchased by Massport.

Deepening of the Main Ship Channel beyond 40 feet in Reach #3 above the East Boston/Fort Point area is not possible due to existing harbor tunnel elevations. The MBTA Subway Tunnel, the oldest and highest of the three tunnels, crosses beneath the channel immediately upstream of the north berth at East Boston Pier #1. Accordingly, only channel widening at the existing 40-foot channel can be considered above this point. Channel improvements in Reach #3 would include channel bend widening at the Charles River Turn.

Reserved Channel

The existing Reserved Channel, as shown in Figure 20 and in aerial photographs in Figure 21, is 430 feet wide by 35 feet deep. An alternative considered is deepening a narrower channel beyond 35 feet. Narrowing the channel by 15 feet along the northern limit was found necessary to avoid adversely impacting the stability of the footing of the concrete pier wall at the Boston Army Base site. Further narrowing of the channel an additional 15 feet along the southern limit would be necessary to provide berthing areas wide enough for the 60,000 DWT vessels which would use the area with improvements. Bulk carriers, containerships and passenger vessels are commonly berthed along both sides of the channel, with tugs being used to maneuver vessels into their berths. Some safety clearances are necessary between the maneuvering vessel with its tugs and the berthed vessels on either side. Incremental depths considered were 38 and 40 feet over a 400-foot width.

Depths in excess of 40 feet were considered for the Reserved Channel. To establish such depths, however, the seaward access and entrance channels must also be deepened. To deepen the Reserved Channel,

Main Ship Channel, President Roads Shipping Channel and the Broad Sound North Entrance Channel as a single project would cost between $27 and 33 million and would involve annual costs for dredging alone at $2.5 to 3 million. Shore facilities modifications, particularly storage capacity expansion would also be necessary. With demand for petroleum expected to perhaps decline somewhat or, at best, remain stable it is improbable that a net benefit would accrue from deepening beyond 40 feet.

Vessels now using the Reserved Channel have difficulty maneuvering into and out of the channel. Most larger vessels are currently required to be backed into the channel by tugs, or backed out with assistance upon leaving. Vessel traffic in the Main Ship Channel must be halted during such turning operations. A widened channel at the confluence with the Main Ship Channel would enable ships of greater length than those for which the 35-foot channel was designed to use the Reserved Channel without tug assistance or tide delays thereby reducing traffic hazards in the Main Ship Channel due to turning vessels.

Creation of a widened maneuvering area of the same incremental depths at the confluence of the Reserved Channel and Main Ship Channel was considered. This turning basin would be located between the northern limit of the Reserved Channel, and the southern limit of the 40 -foot Navy Drydock approach channel, off the end of the Boston Army Base Pier. Modification of existing harbor lines are necessary to facilitate dredging of the turning basin.

Inner Confluence Area

The Inner Confluence Area at the head of the Inner Harbor, as shown in Figure 22 and in aerial photographs in Figure 23, is presently dredged to 35 feet. Both the Mystic and Chelsea Rivers join the harbor at this point. The deepening of either the Mystic or Chelsea River Channels would also involve deepening of this area. Incremental depths were considered as for the two rivers, namely 38 and 40 feet.

Mystic River

The existing 35-foot Mystic River Channel, as shown in Figure 24 and in aerial photographs in Figure 25, varies in width from about 940 feet at its lower end to 1,060 feet at a point about 1,200 feet below the Malden Bridge. The channel narrows to 150 feet at the Malden Bridge where access to the 20-foot Somerville turning basin and the upper Mystic River small boat channel begins. Maintenance of a portion of the 35-foot channel at the upstream end along the southern Charlestown shoreline is currently abandoned. This southern half of the channel, which extends for about 500 LF, has never been maintained due to the waterfront's use as a public playground. It will not be considered for further deepening. The remaining areas of the Mystic River Channel as shown in Figure 24 were considered for deepening to 38 and 40-foot increments.

Chelsea River

The Chelsea River Channel, as shown in Figure 26 and in aerial photographs in Figure 27, is the destination and terminal area of the largest total volume of petroleum imports in the Boston Area. The existing 35-foot channel has varying widths, generally 225 feet upstream to a turning basin. Two bascule bridges impose width restrictions of 175 and 96 feet. Due to the restrictive nature of the shoreline and terminal facilities, widening of the channel is not considered. Vessels requiring a 40-foot depth now transit the entire channel and pass through both bridges. The upper bridge (Chelsea Street) with its 96-foot horizontal clearance is frequently struck by vessels and incurs significant damage. The city of Boston, owner of the bridge, is currently planning replacement of the fender system to provide a 96-foot opening. Deepening to 36, 38 or 40 feet would benefit existing traffic without requiring bridge modification. However, to avoid the continuation of this restricted width opening, the replacement or modification of this structure by others is suggested. This bridge effectively divides Chelsea traffic into two distinctly separate fleets of vessels.

The narrow confines of the Chelsea River have resulted in the adoption of special management measures by users and pilots. Whereas two tugs are normally used for vessels bound elsewhere in the harbor, four tugs are used with Chelsea-bound vessels to effect a greater degree of maneuverability in the confined winding channel. Immediately below the Chelsea Street Bridge, two major terminals, Mobil in East Boston and Northeast Petroleum in Chelsea are opposite the channel from each other. Only one of these terminals, Mobil, receives deliveries at this time. The Northeast Terminal is presently inactive and its berth remains at about 32 feet. Bulkheads at this facility were recently undermined by passing vessel wakes and some repairs have been made. When a large vessel is docked at Mobil it leaves the majority of the federal channel and the unoccupied berth open for vessel transit.

This situation results from currently used vessel beams being greater than those for which the 35-foot channel and berthings were designed. The limits for the channel through this reach are thus considered flexible by the users. Moving the terminals back would displace storage capacity and relocating the displaced storage capacity further landward would displace residential and other commercial properties. The high cost associated with such relocations makes a continuation of the existing "flexible" channel arrangement the most practical alternative. While damage to the bridge itself has occured, no vessel-to-vessel or vessel-to-dock accidents have been reported.

Dorchester Bay Channel

The existing channel is 18 feet deep to the Port Norfolk area of Dorchester and then 15 feet deep to the mouth of the Neponset River channel. An authorized improvement calling for a 35-foot deep, by 300-foot wide channel with turning basin from the Main Ship Channel to Port

MAJOR HARBOR IMPROVEMENT STUDY
BOSTON HARBOR, MASS
ENTRANCE CHANNELS
EXISTING PROJECT LIMITS
FIGURE 16
DEER ISLAND
ANCHORAGE
PRESIDENT ROADS
GEORGES ISLAND
LONG ISLAND
40-FOOT MAIN DEEP CHANNEL
35-FOOT ANCHORAGE
35-FOOT CHANNEL
30-FOOT BROAD SOUND SOUTH CHANNEL
27-FOOT MARKER CHANNEL
40-FOOT BROAD SOUND NORTH CHANNEL
35-FOOT BROAD SOUND NORTH CHANNEL
13 Foot Rubble Channel
Bumpkin Island
Lovells Island
Gallops Island
Outer Brewster Island
Middle Brewster Island
Little Brewster Island
Boston Light
Deer Island Light
Long Island Head Light
Nantasket Beach
Hull
Point Allerton
Boston Harbor
Hingham Bay
Weymouth Fore River
Quincy Bay
Dorchester Bay
Boston
Chelsea Creek
Mystic River
Charles River
Inner Harbor
Fort Point Channel
Reserved Channel
Broad Sound
Hull Bay
Nantasket Roads
Hingham Harbor
Weymouth Back River
Quincy
Dorchester
Chelsea
Winthrop
Revere
Boston Harbor
Mean Low Water
COAST OF ENGLAND
U.S. ARMY

LOGAN AIRPORT
EAST BOSTON
CHARLESTOWN
PLEASURE BAY
SPECTACLE ISLAND
MAVERICK SQUARE
MAIN CHANNEL
MELROSE

BOSTON HARBOR
PLEASURE BAY
CASTLE ISLAND
GOVERNORS ISLAND
CONSTITUTION CHANNEL
35' MAIN SHIP CHANNEL
40' MAIN SHIP CHANNEL
BOSTON NAVY BASE
MASSPORT MARINE TERMINAL
BOSTON GAS COMPANY
MOBIL FUEL CO.
PROPOSED
EXISTING
FIGURE 20

View to East - September 17, 1985 - By Richard DeSimone

View to Southeast - September 17,1985
By Mark Habel

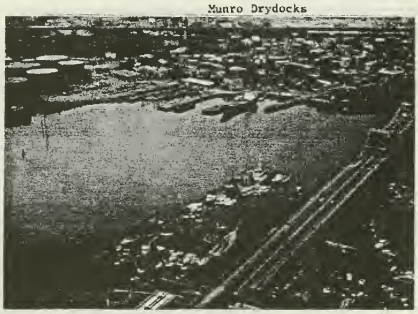
BOSTON HARBOR, MASSACHUSETTS

FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT

FIGURE 21

AERIAL PHOTOGRAPHS
RESERVED CHANNEL

CHELSEA RIVER
35' TURNING BASIN
35' CHANNEL
40' MAIN SHIP CHANNEL
MYSTIC RIVER
WHITE BRIDGE
MYSTIC AVENUE BRIDGE
CHELSEA STREET BRIDGE
MAIN STREET BRIDGE
CHARLESTOWN
CHELSEA
EAST BOSTON
BOSTON
LOCATION MAP
VICINITY MAP
WHITE BRIDGE IMPROVEMENT STUDY
BOSTON HARBOR, MASS.
INSET CONSTRUCTION AREA
EXISTING PROJECT LIMITS
FIGURE 22



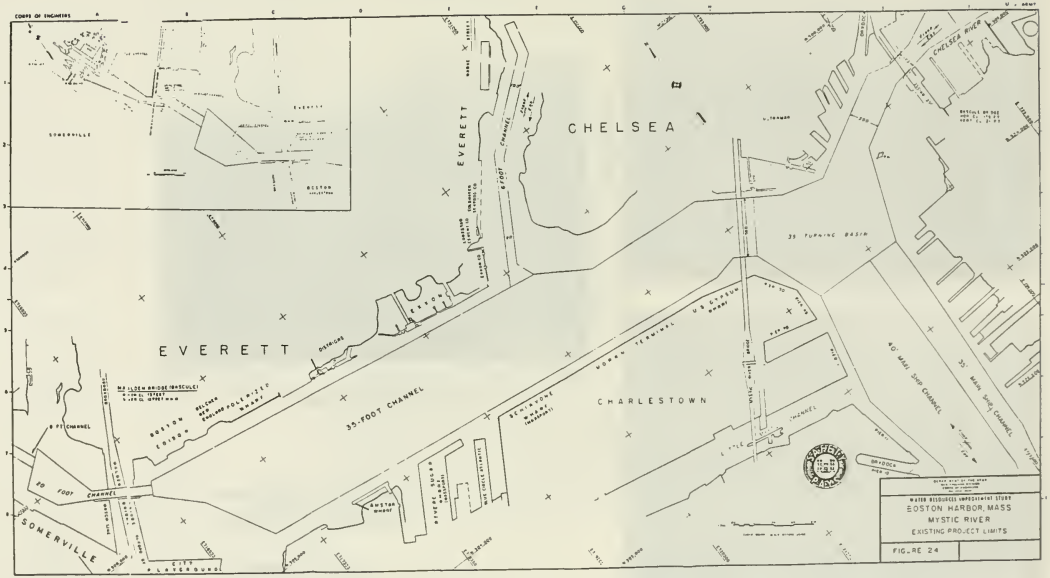
VIEW TO NORTHWEST TOWARD CHELSEA - MCARDEL BRIDGE ON RIGHT - JUNE 8, 1987 - MARK HABEL

Munro Drydocks
VIEW TO SOUTH - MCARDEL BRIDGE ON LEFT - SEPTEMBER 17, 1985
MARK HABEL

BOSTON HARBOR, MASSACHUSETTS
FEASIBILITY REPORT
FOR NAVIGATION IMPROVEMENT

FIGURE 23

AERIAL PHOTOGRAPHS
INNER CONFLUENCE

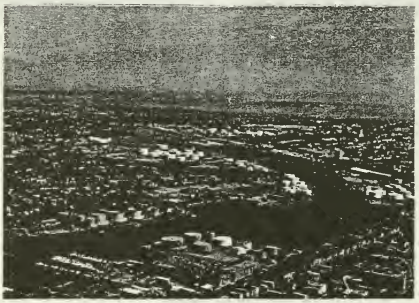

CHELSEA
EVERETT
CHARLESTOWN
SOMERVILLE
35-FOOT CHANNEL
40 FOOT CHANNEL
35 FOOT CHANNEL
40 FOOT CHANNEL
35 TURNING BASIN
40 FOOT SHIP CHANNEL
35 FOOT SHIP CHANNEL
CHELSEA RIVER
MYSTIC RIVER
MYSTIC RIVER BRIDGE
MYSTIC AVENUE BRIDGE
MYSTIC AVENUE
MYSTIC RIVER
WATER RESOURCES RECONNAISSANCE STUDY
BOSTON HARBOR, MASS
MYSTIC RIVER
EXISTING PROJECT LIMITS
FIGURE 24

VIEW TO EAST - MALDEN BRIDGE AT BOTTOM - SEPTEMBER 17, 1965
RICHARD DISIMONE

BOSTON HARBOR, MASSACHUSETTS
FEASIBILITY REPORT
FOR NAVIGATION IMPROVEMENT
FIGURE 25
AERIAL PHOTOGRAPHS
MYSTIC RIVER CHANNEL

BOSTON HARBOR, MASS
CHELSEA RIVER
EXISTING PROJECT LIMITS
FIGURE 26
CHELSEA
EAST BOSTON
CHARLESTON
MAIN SHIP CHANNEL
35 FOOT CHANNEL
40' MAIN SHIP CHANNEL
CHELSEA ST BRIDGE
MYSTIC RIVER
CHELSEA RIVER

VIEW TO SOUTH - TURNING BASIN AREA - SEPTEMBER 17, 1985
BY MARK HABEL



VIEW TO NORTHEAST - ENTIRE LENGTH OF PROJECT
SEPTEMBER 17, 1985 - BY RICHARD DESIMONE

BOSTON HARBOR, MASSACHUSETTS
FEASIBILITY REPORT
FOR NAVIGATION IMPROVEMENT

FIGURE 27

AERIAL PHOTOGRAPHS
CHELSEA RIVER CHANNEL

Norfolk has never been dredged due to a decline in economic justification. In addition, the existing channel serves one major commercial user, the Boston Gas Company. The channel is adequate for its volume of recreational traffic, and no further modifications will be considered. Therefore the Dorchester Bay Channel was not carried forward for more detailed analysis.

Outer Confluence Area (President Roads Shipping Channel)

The Outer Confluence area at President Roads off Deer Island Light presents a naturally deep channel area with depths of 40-60 feet MLW. Vessels transit this area between the Main Ship Channel and the three entrance channels (Broad Sound North, Broad Sound South and the Narrows Channels). The President Roads Anchorage is situated along the northern limit of this area. Currently Coast Guard buoys mark the traffic lanes through this area. No Federal channel limits have been declared for the 7000-foot-long reach that joins the Main Ship Channel with the three harbor entrance channels as shown in Figure 28. The marking of specific jurisdictional channel limits through this area could result in a larger anchorage at President Roads without the need for dredging improvements as the area is naturally deep. Therefore, an alternative was developed to set limits from the upstream end of the entrance channels at the Outer Confluence through President Roads to the downstream end of the Main Ship Channel.

Initial Screening of Alternatives

Entrance Channel Modification

Projected increases in petroleum and LNG imports, as envisioned as a future condition throughout the 1970's, have not, and are not expected to occur for sometime in the future. The petroleum market remains glutted with available supply, a condition which is expected to continue in the near term. Retail prices are expected to remain lower than those of a decade ago. In light of these conditions, the widespread use of increasingly deeper draft petroleum tankers beyond 60 to 80,000 DWT is not projected for Boston Harbor.

The largest of the vessels currently in use find the 40-foot entrance channel and anchorage depth adequate. Further, these vessels lighter and/or ride the tide to gain access to their 40-foot berths along the 35-foot tributary channels. Consequently deepening of any portion of the Broad Sound North Entrance Channel, the President Roads Anchorage, or the Main Ship Channel beyond 40 feet is not considered to be economically justifiable, or necessary at this time.

At Finns Ledge, the north entrance channel from Broad Sound makes a 26 degree turn to the left when inbound. At this turn, the only turn in an otherwise straight entrance channel, the 40-foot deep section of channel narrows from 1,100 to 900 feet. This area is located well outside

of the protected reaches of the Outer Harbor. Wind and wave conditions commonly exert forces on vessels underway in excess of those encountered inshore of the Deer Island Light. Due to squat, pitch and yaw allowances, when added to the roll produced by a turning vessel in even moderate seas, larger vessels must ride the tide to some degree in order to safely pass this first channel bend. The removal of Finns Ledge to provide a straight channel at 40 feet would eliminate the additional depth needed to compensate for the roll of larger vessels when turning. Thus, the removal of a portion of Finns Ledge to provide a straight entrance channel would meet the needs of existing deep draft traffic without the need to deepen the entire entrance channel and anchorage system beyond the 40 feet now provided. However, it is noted that the turn does not pose a significant restriction on existing vessel traffic. No vessels have failed to use he port because of the turn and no measurable benefits would result from modifications. Elimination or easing of this turn was determined to be uneconomic. Therefore the alternatives examined for the Broad Sound North Entrance Channel, as shown in Figure 29, were not carried forward for detailed analysis.

Anchorage Area Modifications

The number of vessels using the anchorage for lightering or awaiting the rising tide is not expected to increase in the near future if other improvements, namely tributary deepening, are made. If the existing 35-foot tributaries are deepened, the number of waiting vessels would actually decrease. Traffic volumes in the Port of Boston, while increasing, are not so great as to require a large number of vessels to wait for berthing space. On this basis deepening or enlargement of the President Roads Anchorage Area was not carried forward for detailed study.

Access to the proposed Deer Island Secondary Sewage Treatment Plant's pier would require a fairway to be cleared through the anchorage for transport of construction equipment and workers to the site and removal of sludge to ocean disposal sites. However, such a fairway would not be frequently used and would not take up a significant amount of anchorage space. By declaring specific federal channel limits through President Roads, the added area would likely exceed that taken up by the aforementioned fairway.

Main Ship Channel

Inasmuch as our studies found that deepening of the Entrance Channel-Anchorge System lacked economic justification, deepening of any portion of the Main Ship Channel beyond 40 feet was not considered. However, widening of the 40-foot deep portion of the channel either at critical bends or in its entirety was considered on a reach-by-reach basis, as required by vessel sizes, their maneuverability, and traffic volume.

The Main Ship Channel was considered as three reaches: namely, 1) President Roads to Reserved Channel, 2) Reserved Channel to Fort

Point/East Boston Piers, and 3) Fort Point/East Boston Piers to the Inner Confluence Area as depicted on Figure 19. The upper segment of these three reaches is the least used by deep draft vessels. Only those vessels landing at the Mystic and Chelsea River terminals require 40-foot depths through this upper reach. Traffic volumes are not significant, and two-way traffic for vessels requiring 40 feet is not required. The existing 600-foot minimum width at the 40-foot depth in the reach above the East Boston Piers is therefore determined as being adequate for existing and projected traffic volumes.

The four deep-draft East Boston Piers, as shown in Figure 12, located at the upstream limit of the second reach were recently purchased by Massport for future maritime use. These are the only East Boston Piers served by rail. The area immediately downstream of these piers is where the 40-foot channel crosses from the outbound to inbound lane. For a short distance (1800 feet) the entire 1200-foot wide channel is 40 feet deep. This provides a ready-made turning area for any deep-draft vessels which would use the East Boston Piers. Downstream of this area, however, the inbound 600-foot wide channel lane is only 35 feet deep to the Reserved Channel Area and beyond to President Roads. Also located along this reach between the Reserved Channel and Fort Point is the Boston Shipyard Corporation piers on the East Boston side, as shown in Figure 13. On the South Boston side are the State's Boston Fish Pier, Commonwealth Pier #5, General Shipyard Corporation's Piers and Drydock, the Boston Marine Terminal Wharf, and the port's only 40-foot dry dock (the former U.S. Navy Drydock #3).

Should a significant increase in future deep-draft use in this reach occur, particularly for the East Boston Piers and Massport Marine Terminal, then the resulting traffic above the Reserved Channel may require a wider 40-foot channel than the 600 feet now provided. However, current vessel traffic projections do not exceed frequencies requiring more than one-way traffic. Therefore, widening of the 40-foot channel in the reaches between the Reserved Channel and the Fort Point/ East Boston Piers Area was not carried forward for detailed analysis.

The downstream reach of the Main Ship Channel between deep water in President Roads and the Reserved Channel currently provides a 40-foot deep by 600-foot wide channel in the outbound (southwest) lane along the South Boston waterfront, and a 35-foot by 600-foot wide channel in the inbound (northeast) lane along the Logan Airport/East Boston shoreline. The only navigation dependent activity along this reach is located on the South Boston waterfront. Facilities include those on the Reserved Channel, as well as Massport's Conley and Castle Island Terminals, the Boston Army Base piers now operated by Massport, and the 40-foot Drydock #3 adjacent to and upstream of the Army Base Piers. Widening of the 40-foot channel along this reach would serve these facilities and all traffic terminating there or originating upstream. If increased traffic should occur in the

future for this and upstream reaches, widening of this reach could be re-examined. However, as with the upstream reaches, future traffic projections do not exceed one-way traffic requirements. Therefore, this alternative was not carried forward for further detailed study.

The alternative improvements examined for the Main Ship Channel reaches are shown in Figure 30.

Reserved Channel

Pilots and terminal operators have expressed a desire to have the 35-foot Reserved Channel deepened and additional widening area provided at its confluence with the Main Ship Channel. The Reserved Channel in South Boston provides deep draft access to Massport's Conley terminals and Boston Army Base, as well as Boston Edison's oil-fired South Boston plant and the petroleum terminals of Belcher New England, Inc. The Conley Terminal handles general cargo, containers and break-bulk cargos, while the former Boston Army Base is used for cruise ships, general and break-bulk cargos.

The existing 430-foot wide 35-foot deep channel departs from the 40-foot Main Ship Channel when inbound at a 40-degree angle. This does not present too much of a problem to large vessels entering or leaving the channel bow first. However, when the vessels enter or leave stern first they must make a tug assisted 140-degree turn upstream into the Main Ship Channel. This presents particular problems for the larger fuel carriers whose 700 to 900-foot lengths far exceed the 600-foot width of the channel they are attempting to turn into. It has been requested by local interest that any modifications of the Reserved Channel include the provision of a widened maneuvering area to the north of the channel's confluence with the Main Ship Channel.

The terminals at the upstream end of the channel, Massport's Black Falcon Cruise Ship Terminal and Boston Edison Company's Wharf do not presently require depths greater than 35 feet. The largest cruise ships and military craft docking at Black Falcon draw no more than 32 feet. Maintenance of the existing channel and berth depths to 35 feet would eliminate the current depth problems. Boston Edison has not received a deep draft tanker at its wharf in over ten years. Edison leases terminal rights and storage at the Belcher South Boston Facility allowing it to arrange for its own cargos and shippers and take advantage of Belchers deeper berth. It is expected that this arrangement will continue. Two channel length alternatives have been developed and evaluated. One would deepen the entire existing channel length and will be called the "Full Length Plan". The other would exclude the final 1340 feet of channel above the Belcher berth and will be called the "Reduced Length Plan".

As with the Mystic and Chelsea 35-foot tributary channels, the Reserved Channel is already used by vessels requiring a 40-foot depth. These vessels wait outside the harbor, or in the anchorage, for the proper

PRESIDENT ROADS
35 FOOT ANCHORAGE
353 ACRES
GOVERNORS ISLAND

ALTERNATIVE – 1
REMOVE THE SOUTHEAST PORTION OF FINNS LEDGE TO FORM A STRAIGHT ENTRANCE CHANNEL
ALTERNATIVE – 2
PROVIDE A CHANNEL BEND CUTOFF ON THE INSIDE OF THE FINNS LEDGE TURN
33' - 7000' ROAD BOARD BOARTS CHANNEL
60' - 7000' ROAD BOARD BOARTS CHANNEL
40' - 7000' ROAD BOARD BOARTS CHANNEL
DEER ISLAND
BASSOUS CHANNEL
27' - 7000'
WATER RESOURCES APPRAISAL STUDY
BOSTON HARBOR, MASS.
BROAD SOUND
ENTRANCE CHANNELS
FINNS LEDGE ALTERNATIVES
FIGURE 29

LOGAN AIRPORT
EAST BOSTON
CHARLESTOWN
CHELSEA
PIERCE'S
BAR

tide to enable them to navigate the 35-foot channels to reach their 40-foot berthing areas. Provision of a deeper Reserved Channel would allow these vessels full tide access to their berths. This together with further berthing area deepening would allow even larger vessels to use the Port of Boston, using the same tidal strategy as is currently practiced. The deepening of the Reserved Channel and the provision of an adequate turning area at its mouth was carried forward for detailed consideration.

Mystic River Channel

The 35-foot Mystic River Channel provides access to the most diverse group of maritime industries in the Port of Boston. Boston Edison's oil-fired Everett generating plant is located at the upstream limit. Two scrap metal exporters, Prolerized and Schiavoni, are located on the Everett (north) and Charlestown (south) shores respectively. The Schiavoni property was recently purchased by Massport which plans to expand the Moran Container Terminal. Also located in Charlestown are Domino Sugar, Amstar Sugar, Revere Sugar (wharf property recently purchased by Massport), Blue Circle Atlantic Cement, U.S. Gypsum and Massport's Moran container terminal. Distrigas (LNG), Exxon, Belcher Oil, Coldwater Seafood and Independent Cement (formerly Lonestar) are located along the Everett shore downstream of Boston Edison. Many of these facilities have already deepened their berths to 40 feet allowing larger vessels to ride the tide to gain access. Principal benefits to channel deepening would derive from petroleum and LNG imports, and to a lesser extent, scrap exports (at this time Prolerized only). Deepening of the Mystic River Channel was carried forward for detailed consideration.

Along the channel's southern or Charlestown shore navigation dependant activity no longer occurs at the far upstream end at Ryan Park. The facilities between Ryan Park and the Schiavone Wharf still require access at the 35-foot depth, but have not been identified as benefitting from any deepening. Two Mystic River alternatives were developed. One would deepen the entire channel except for the area along the southern limit at Ryan Park and will be known as the 'Full Width Plan'. The second would extend the excluded area eastward along the southern limit to Schiavone, and will be known as the 'Reduced Width Plan'. In both cases the channel along the northern limit or Everett shore that would be deepened to access beneficiary facilities would be designed to accomodate one-way traffic at a width of 440 feet.

Chelsea River Channel

The existing 35-foot Chelsea River Channel serves the area's largest group of petroleum importers. Many terminals now have berths deeper than the 35-foot channel depth to allow vessels to reach their facilities on the high tide. Quincy Oil, Texaco, Northeast Petroleum, Amoco, Gulf Oil, Belcher Oil, Gibbs Oil, Mobil Oil, Amerada Hess and Global Petroleum all maintain facilities along the Chelsea River Channel.

Benefits to deepening the Chelsea River Channel, either below the Chelsea Street Bridge only or in its entirety, would be entirely due to petroleum imports. Deepening of the Chelsea River Channel was carried forward for further detailed study.

Inner Confluence Area

Deepening of the Mystic and/or Chelsea River Channels would involve deepening of the Inner Confluence area which lies between the river mouths and at the head of the existing 40-foot Main Ship Channel. Several facilities are located at the Inner Confluence; Ultramar Petroleum, Massport's Mystic Piers 48-50, Monroe Drydocks and the Boston Tow Boat Company.

The turning of larger vessels into and out of the Chelsea and Mystic River Channels poses problems similar to those encountered at the Reserved Channel. Vessels entering or exiting either river must be turned in the Inner Confluence at least once in their round trip through the harbor. Vessels often ground on the east bank of the Inner Confluence, along the western waterfront of East Boston. This most often occurs when vessels are being maneuvered so as to enter either channel stern first. The problem is also encountered by vessels which enter or leave the Chelsea River Channel bow first.

Massport officials are also concerned with the risk of damage to the Mystic-Tobin Bridge's north pier posed by large vessels or barge tows entering the Mystic River. Many vessels choose to enter the rivers bow first rather than assume the higher risk involved with a grounding on the east bank of the Inner Confluence with a fully loaded vessel. These vessels must then back out of the river channels assuming the greater vessel damages involved with a stern grounding.

All such risks of grounding and bridge pier damage could be alleviated by widening the Inner Confluence, along the western waterfront of East Boston. This would include widening the confluence at the entrance to the Chelsea River and widening the junction of the confluence and inbound lane of the 40-foot Main Ship Channel. Thus, widening of the Inner Confluence would be considered in any plan to deepen that area in conjunction with deepening either or both the Mystic River and Chelsea River Channels.

Outer Confluence Area and Channel Through President Roads

There are no Federal channel limits between the three harbor entrance channels and the downstream end of the Main Ship Channel. The southern limit of the President Roads Anchorage allows room for a buoyed channel about 1800 feet wide from Deer Island Light to the Main Ship Channel, far in excess of that required by future traffic and vessel size projections.

A designated channel through this area must be at least as wide as the 1200 feet provided by the existing Main Ship Channel and provide

sufficient width for vessels turning into or out of the anchorage. Channel limits must be also provide for the merger of the three harbor entrance channels at the Outer Confluence area south of the Deer Island Light in President Roads. The three entrance channels have widths of 1000, 1200, and 1500 feet. Designation of a channel 1200 feet wide between the Outer Confluence, and the Main Ship Channel would satisfy the needs of existing and projected traffic. It would also result in enlarging the effective area of the President Roads Anchorage by about 70 acres, a 20 percent increase, all at no cost to the Federal government or the local sponsor. Such designation would also serve to make the Boston Harbor project complete within itself by providing continuous Federal channel limits between the upstream limits of the various Federal projects and the open ocean.

ALTERNATIVES SELECTED FOR DETAILED ANALYSIS

In summary, the alternatives found justified further consideration are as follows:

A) PRESIDENT ROADS CHANNEL; designating Federal channel limits between the three harbor entrance channels and the Main Ship Channel to provide a complete within itself project, while increasing the effective area of the President Roads Anchorage. This measure would require only the relocation of several navigation aids at the time of their next scheduled maintenance.

B) RESERVED CHANNEL AND WIDENING CONFLUENCE; deepening the 35-foot channel to 38 or 40 feet, and providing a widened maneuvering area of equal depth along the northern limit at the confluence with the Main Ship Channel. Deepen either the entire channel length or a reduced length excluding the upper 1340 feet. Depths beyond 40 feet are possible for this channel located downstream of the tunnel crossings but would require deepening the entrance channel, anchorage and Main Ship Channel as well.

C) MYSTIC RIVER CHANNEL AND INNER CONFLUENCE; deepening the existing 35-foot Mystic River Channel to 38 or 40 feet except for that portion along the southern side of the upstream limit now adjoining Ryan Park, together with widening the Inner Confluence along the western waterfront of East Boston and deepening to 38 or 40 feet to allow deepening of the Mystic River Channel and/or the Chelsea River Channel. A 'Full Width Plan' would exclude only the area adjoining Ryan Park. A 'Reduced Width Plan' would extend the area excluded from deepening downstream from Ryan Park to the Schiavone Wharf.

D) CHELSEA RIVER CHANNEL; deepening the existing 35-foot channel to 36, 38 or 40 feet over its entire length or only in the reaches downstream of the Chelsea Street Bridge.

E) COMBINED TRIBUTARY PLAN; Combining the four above plans into an overall plan of improvement for Boston Harbor using the optimized depths identified for each tributary channel. Savings in unit costs, contract administration, etc., would result.

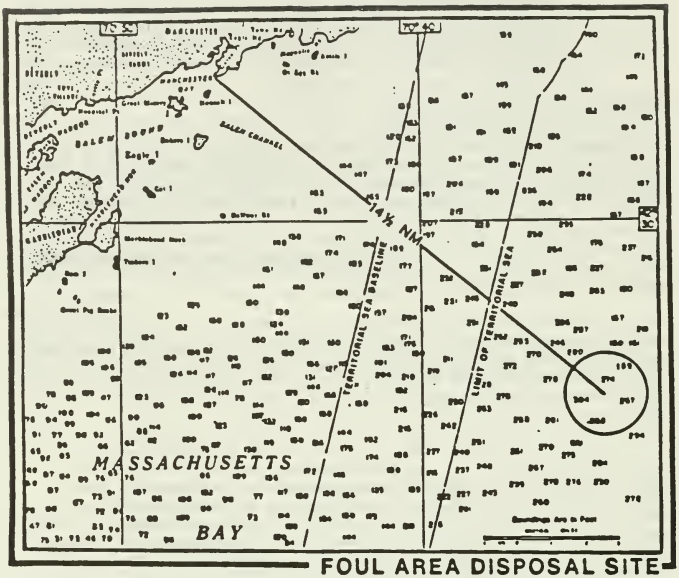
DREDGED MATERIAL DISPOSAL OPTIONS

Disposal of dredged material from this project was assumed to be at the Foul Area. Based on the information collected to date, and the New England Division's extensive experience with and study of open water disposal at this site, the dredged material is considered suitable for such disposal. Further testing, including Bioassay-Bioaccumulation studies will be necessary to confirm this determination. However, the high cost and limited "shelf life" through which such test results are considered valid requires defferal of these investigations until such time as the project is pending authorization.

A clamshell or other bucket dredge will load the excavated material from the proposed project site onto barges to be transported approximately 25 nautical miles east to the Foul Area Disposal Site. This disposal will require between about 500 and 1,600 round trips, depending on the alternatives chosen and barge capacity, from the project area to the disposal buoy.

The site, as shown in Figure 31, is located in Massachusetts Bay in about 300 feet of water, is an Environmental Protection Agency (EPA) approved interim site with a circular boundary of two nautical miles diameter as identified in the Federal register as Marblehead (40 CFR 228.12). The center of the site is 42^{o}-25.7' north latitude and 70^{o}-34.0' west longitude, approximately 14.5 nautical miles southeast of Manchester Massachusetts, 26 nautical miles northwest of Race Point, Provincetown, Massachusetts and 10 miles south southeast of Eastern Point, Gloucester, Massachusetts. This disposal site is locally called the Foul Area because of the many fishing net "hangs" that could foul the equipment. This site has received approximately 3 million cubic yards of dredged material between 1975 and 1986, a majority of which came from Boston Harbor dredging projects. The clay, silty sand and sandy silt to be dredged from the proposed improvements in Boston Harbor is typical of the materials previously deposited at the Foul Area.

The general vicinity of the Foul Area Disposal Site (FADS) has received wrecks, dredged material, organic and inorganic compounds and construction debris since the 1940's. Earlier disposal was not at a specified point, but sufficiently far from land to reduce the impacts of disposal. Most dredged material was disposed at sites closer inshore, especially the "Boston Lightship" Disposal Site. Some dredged material then considered 'contaminated' or oil laden was disposed at the offshore area eventually termed the "Foul Area." Often Boston Harbor dredged material, including Dorchester Bay, has been disposed at the Foul Area Disposal Site (FADS) because of the silt content of the substrate.



Description: This site is a circular area with a diameter of 2 nautical miles and center at 42°-25.7'N, 70°-34.0'W. From the center, the Marblehead Tower bears true 282° at 24,300 yards and Baker Island Horn bears true 300° at 24,300 yards. The authorized disposal point (within the overall disposal area) is specified for each dredging project in other project documents. Depth Range: 159 to 304 feet MLW

NOTE: The map depicts the disposal site's location in relation to landmarks. It is not intended for use in navigation.

BOSTON HARBOR, MASSACHUSETTS

FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENTS

FIGURE 31

RECOMMENDED OCEAN DISPOSAL SITE

The material to be disposed from this project area during construction and subsequent maintenance dredging activities must have a low energy environment for stability in containing the dredged materials within the designated site. Any rock could be used to create reef habitat and remain stable at any site. During the past disposal activity at FADS, 62.1 percent of all material was silt and clay and 37.3 percent was sand; the remaining 0.6 percent was gravel. Much of the material disposed was a mixture of sandy silt. The Foul Area Disposal Site has received this material because of the stable nature of this deepwater offshore site. Nearshore disposal could allow storm activity to resuspend dredged silt and clays. Upland disposal sites are few and expensive on this urban coastline. The majority of material at FADS, in cubic yardage, has come from Boston Harbor (67 percent) with harbors south of Boston comprising 20 percent of the material historically disposed at FADS. The remaining 13 percent was generated from dredging projects in harbors north of Boston to Rockport, Massachusetts. The composition of chemical and biological parameters at FADS has been the subject of intensive scientific analysis by the New England Division which has the responsibility to manage and monitor the disposal of dredged material at this site.

Sasaki and Associates (1983) conducted an extensive survey of the Boston Harbor area for disposal site alternatives (upland, containment, etc.). Their report indicated three upland sites available in the vicinity of the proposed dredging project, that do not require intertidal fill. These sites are 0.7 acres (13,000 cubic yard capacity) along the south side of the Charles River and three acres (85,000 cubic yard capacity) west of Dorchester Avenue and privately owned (Monsanto) areas along the Mystic River (Sasaki & Associates, 1983). After review of environmental and economic feasibility, using nine siting criteria developed for the Commonwealth of Massachusetts' Office of Coastal Zone Management, these sites are not considered viable. The Monsanto sites are not available according to the report. One site is currently in the area of the proposed Third Harbor Tunnel project for airport access and although it may be capable of retaining 85,000 cubic yards, it is not currently available for other project uses. The small Charles River site included in the Sasaki (1983) report is also identified as nonviable by the report for environmental concerns, economic constraints, and poor accessability (through Charles River locks).

The most practical alternative is barge disposal at the Foul Area Disposal Site. This ocean disposal site is being extensively monitored and managed by the Corps of Engineers to meet the dredged material disposal needs of the greater Boston region.

PRESENTATION AND EVALUATION OF DETAILED PLANS

The section presents the alternative plans chosen for detailed analysis. The impacts of the various plans were evaluated for each increment and compared. Each of the major channel segments was evaluated in detail as incremental to an overall combined plan of improvement for Boston Harbor. Plans were evaluated as to the impacts on navigational efficiency, environmental, social and cultural resources and engineering feasibility relative to the projected without project conditions. The degree to which each plan and increment met the planning objectives was also considered.

GENERAL ASSESSMENT OF PLANS AND IMPACTS

Plans were developed for each of the three major tributary channels, the Reserved Channel, Mystic River and Chelsea River. Each of the three channels was evaluated at 38- and 40-foot increments. The Chelsea River Channel was also evaluated at 36 feet, and the Mystic River and Reserved Channel at 42 feet. In developing plans for the Mystic River, deepening of the Inner Confluence area was included at equivalent depths. The provision of a turning area at the mouth of the Reserved Channel is also included in the plans for that channel. The tributary improvements evaluated are as follows:

(A) A plan was developed, not entailing any structural alterations, which would effectively enlarge the President Roads Anchorage area without the need for dredging. This plan involves the designation of specific Federal channel limits through President Roads connecting the Outer Confluence of the entrance channel with the Main Ship Channel as shown in Figure 32. This would allow the enlargement of the anchorage southward into waters up to 60-feet deep. Adoption of this plan would increase the size of the anchorage by about 20 percent or 70 acres, at no cost.

(B) Reserved Channel

1) Narrow the channel to 400 feet by relocating the channel limits along the Army Base Wall and southern berthing areas and provide a widened maneuvering area at the channels confluence with the Main Ship Channel off the Army Base Pier. Deepen the narrowed channel and widened confluence to -38 feet.

2) Deepen the above channel for its full length and confluence to -40 feet.

3) Deepen a reduced length channel excluding the upper 1340 feet and include the widened confluence to -38 feet.

4) Deepen a reduced length channel as above to -40 feet.

5) Deepen a reduced length channel to -42 feet including deepening the Main Ship Channel Reach #1, the President Roads Ship Channel and the Broad Sound North Entrance Channel.

(C) Mystic River and Inner Confluence

1) Widen the Inner Confluence along the East Boston shore and exclude only the far upstream area of the Mystic River Channel along the Charlestown playground from future deepening. Deepen the Inner Confluence and this 'Full Width Plan' Mystic River Channel to -38 feet.

2) Deepen the above 'Full Width Plan' channel and widened confluence area to -40 feet.

3) Extend the area excluded from deepening along the southern limit east to the Schiavone Wharf and deepen the remaining 'Reduced Width Plan' channel to -38 feet.

4) Deepen the above 'Reduced Width Plan' channel to -40 feet.

5) Deepen the 'Reduced Width Plan' channel to -42 feet together with deepening Reaches #2 and 3 of the Main Ship Channel. This plan would be incremental to the Reserved Channel 42-foot plan.

(D) Chelsea River Channel

1) Deepen the existing channel limits either downstream of the Chelsea Street Bridge only or for the entire channel length to -36 feet.

2) Deepen the existing channel limits either downstream of the Chelsea Street Bridge only or the full channel length to -38 feet.

3) Deepen the existing channel limits either downstream of the Chelsea Street Bridge only or for the full channel length to -40 feet.

(E) Combine the above four plans into an overall plan of improvement for Boston Harbor for both the 36, 38-foot and 40-foot depths or combinations thereof and including the President Roads Channel and Anchorage realignment. This plan will be referred to as the Combined Tributary Plan.

Dredging Impacts

All of the Inner Harbor structural alternatives considered, the Main Ship Channel widening and tributary channel deepening, would involve the same general dredging impacts. Silty clayey sand and blasted ledge would be removed by bucket dredge and placed in scows for towing to the disposal site. Dredge site area turbidity would increase during actual dredging

PRESIDENT ROADS
40-FOOT ANCHORAGE
ENLARGED TO 420 ACRES
RECOMMENDED CHANNEL AND
ANCHORAGE REALIGNMENT
GOVERNORS
ISLAND

operations and the existing benthic environment and its community would be removed. Dredging operations would interfere with normal vessel traffic to some extent. However, this could be minimized by careful attention to scheduling of operations and ship traffic. Blasting would be required at the Mystic River, Inner Confluence Area, and Reserved Channel Confluence. Dredging volumes for the various incremental plans under consideration are shown in Table 17.

Disposal Impacts

Disposal of dredged materials is anticipated to take place at the Foul Area located in Massachusetts Bay. The site is located about 16 miles from Finns Ledge and 27 miles from the upstream limit of the Chelsea River Channel. The dredged material would be point dumped at a buoy located within the disposal site or through some other means of controlled dumping so as to minimize the area of bottom to be covered by dredged material. Disposal in this manner would temporarily destroy the benthic community covered by the pile of dredged material. Recolonization of the area by benthic organisms would begin soon after disposal operations ceased. The disposal site is shown in Figure 31.

The Foul Area has historically been the most active disposal site off the Massachusetts coast. The site was used for disposal of a total of about 1,200,000 cubic yards of dredged material in 1982-83 including material dredged from maintenance of the Federal channels in Boston Harbor. Numerous other activities by private parties have also resulted in disposal at this site since that time. Grain size and chemical analysis of Boston Harbor sediment have shown it to be compatible with material previously disposed of at this site. A more detailed analysis of dredging and disposal impacts is contained in the Environmental Assessment.

TABLE 17

BOSTON HARBOR, MASSACHUSETTS
DREDGING VOLUMES FOR
DETAILED PLANS

	Cubic Yards to be Removed		
	Ordinary Material	Ledge	Total
A. President Roads Ship Channel nonstructual realignment	no	dredging	required
B. Reserved Channel and Confluence			
1. To -38 feet MLW			
Full Length Plan	409,700	--	409,700
Reduced Length Plan	307,000	--	307,000
2. To -40 feet MLW			
Full Length Plan	584,600	40,000	624,600
Reduced Length Plan	438,000	40,000	478,000
3. To -42 feet MLW Reduced Length Plan includes Main Ship Channel #1 President Roads Channel and Broad Sound North Entrance Channel	1,896,000	160,000	2,056,000
C. Mystic River and Inner Confluence Area			
1. To -38 feet MLW			
Full Width Plan	768,700	33,000	801,700
Reduced Width Plan	660,300	33,000	693,300
2. To -40 feet MLW			
Full Width Plan	1,322,800	54,000	1,376,800
Reduced Width Plan	1,144,800	54,000	1,198,800
3. To -42 feet MLW Reduced Width Plan includes Main Ship Channel Reaches 2 and 3 and Inner Confluence all to -42 feet.	2,686,000	128,000	2,814,000
D. Chelsea River Channel			
Entire Length			
1. To -36 feet MLW	41,500	--	41,500
2. To -38 feet MLW	455,000	--	455,000
3. To -40 feet MLW	770,000	--	770,000
Downstream Reach Only			
1. To -36 feet MLW	28,500	--	28,500
2. To -38 feet MLW	195,500	--	195,500
3. To -40 feet MLW	319,000	--	319,000
E. Combined Tributary Plan			
Mystic Reduced plus Reserved Reduced			
1. To -38 feet MLW	967,000	33,000	1,000,000
2. To -40 Feet MLW	1,583,000	94,000	1,677,000
Mystic Reduced, Reserved Reduced and Chelsea Entire Length			
3. To -38 feet MLW	1,422,000	33,000	1,455,000
4. To -40 feet MLW	2,353,000	94,000	2,447,000
Mystic Reduced and Reserved Reduced at -40, Chelsea entire at -38			
5.	2,038,000	94,000	2,132,000

Impacts on Navigation

Both incrementally and as a combined plan, the considered improvement would result in a safer, more efficient navigation system for Boston Harbor.

The deepening of tributary channels and their associated confluence areas would eliminate or reduce tidal delay for the larger classes of vessels now calling on the Port of Boston. Slightly larger vessels than those now in use would be able to use the harbor with tidal assistance.

In response to the concerns of harbor pilots relative to the width of the Main Ship Channel and the need for greater width in the Mystic River, a Ship Simulation Study is recommended during final design. Such a study would address the harbor pilots request for an addition 150 feet of width in the Main Ship Channel and the Docking Pilots requirements for the full width of the lower reaches of the Mystic River. Such a study is also necessary for confirming the ability to assure project benefits in the Chelsea River where pilots would be reluctant to bring in deeper drafted vessels without a period of experimentation. The cost of such a model study is estimated at $600,000 and will be apportioned among the cost for the three tributary channels.

Designation of Federal channel limits through President Roads would jurisdictionally connect the entrance channels at the Outer Confluence with the Main Ship Channel. Deep-water areas (>40 feet MLW) now marked as part of an 1800-foot wide channel, would be added to the anchorage, increasing its size by about 70 acres or 20 percent while requiring only the relocation of several navigation buoys.

Social and Community Impacts

The proposed alternatives would have varying significant impacts on the community's economy. Savings in shipping costs for bulk petroleum products would result from increased navigational efficiency. It is anticipated that much of these savings would be passed on to consumers. Scrap exporters currently facing stiff competition and lack of demand would experience an enhancement in the viability of their operations, thus retaining a workforce.

Should Massport's efforts at improving Boston's status as a regional container port continue to materialize, the deeper access channels would serve to enhance those efforts.

Economic Impacts

Each of the incremental alternatives would have a positive impact on the economic efficiency of operations for that particularly tributary, or in the case of President Roads, the harbor as a whole. The reduction and elimination of tidal delay would result in reduced fuel, labor and vessel

costs associated with bulk commodity transport. The ability to use larger vessels with tidal assistance would further reduce unit costs of petroleum product delivery or scrap export. All of these increased efficiencies represent a reduction in the value of resources required to transport commodities.

Improved safety, though not directly quantifiable, would also be an impact. The risk of collisions and/or groundings is partially dependent on the density of traffic. Deepening of the channels would enable larger vessels to make fewer total trips, thus decreasing traffic and improving safety. The deepening would also allow vessels, which currently must move within a few hours or high tide, to use the waterway 24 hours a day. This would permit larger vessels to enter or exit at anytime. The traffic volume now confined to high tide will be spread out over the whole day, reducing peak volume and lessening risk.

The proposed deepening of the tributaries would also result in a reduction in the need for existing vessels to engage in tanker-to-barge lightering operations, further minimizing the potential for petroleum product spills. The prevention of a pollution event involving oil or chemicals could mean saving extensive cleanup costs and ecological damage.

Average annual transportation benefits have been evaluated based on a project life of 50 years commencing in 1990 and a discount rate of 8-5/8 percent. It is anticipated that no benefits would accrue to barge traffic using the harbor should project implementation occur. The barges currently in use have drafts fully capable of navigating the existing 35-foot channels.

The full adjustment to use of larger ships is expected to be completed by year five of the project (2000) assuming implementation in 1995. Benefit estimates have therefore been calculated for the period 1995-2000 and following full adjustment for the period 2000-2045. The two periods cover the full 50-year project life period of analysis.

COMPARISON OF DETAILED PLANS

Incremental detailed plans were compared for each major tributary channel segment; Reserved Channel and Turning Area, Mystic River Channel and Inner Confluence, and the Chelsea River Channel. In each case, deepening of the tributary channels was analyzed for incremental depths of -38 and -40 feet MLW. Deepening beyond 40 feet was not considered feasible, due to the tunnel restriction in the case of the Mystic and Chelsea Rivers, and to the requirement to also deepen the entire entrance channel and lower Main Ship Channel system in the case of the Reserved Channel. The nonstructural designation of Federal channel limits from the Outer Confluence Area through President Roads to the downstream end of the Main Ship Channel would be included in any plan of improvement for Boston Harbor.

Cost Comparison

Dredging of ordinary material and blasting and removal of ledge under any of the evaluated plans would be accomplished by bucket dredge, drill barge and scows, with ocean disposal at the Foul Area. Costs are included, incrementally, for additional environmental investigations necessary to determine ultimate suitability of the dredged material for ocean disposal. Rock removed could be deposited less costly at a nearby location to create additional lobster habitat if state and Federal resource agencies so desire and can locate a suitable site. Costs have also been included for removal and relocation of navigation aids in the Mystic River, Chelsea River and Inner Confluence.

Table 18 compares the construction and maintenance costs associated with each incremental alternative for each tributary channel, and the combined tributary plan. Costs are also included for additional dredging of those local berthing areas not already deepened beyond -35 feet. Annual amortization charges were figured at a rate of 8-5/8 percent for a 50-year project life.

Benefit Comparison

Each of the incremented depths included in the detailed plans for each channel segment provides varying degrees of benefits to deep-draft commercial shipping interests, as shown in Table 19.

Benefits are soley attributed to reductions in the value of resources required to transport bulk commodities, petroleum products and scrap metal. These benefits are derived from reduction of tidal delays for existing vessel traffic and use of larger vessels, with and without tidal assistance. The use of larger vessels is assumed to be phased in over a five year period following project implementation. A detailed discussion of project benefits and economic assessments is provided in Appendix 3.

Table 19 also provides a summary of comparison benefits and costs and net economic benefits, given on an annual basis.

TABLE 18
BOSTON HARBOR, MASSACHUSETTS
COSTS OF DETAILED PLANS

	B Reserved Channel Reduced Length And Widened Confluence			C Mystic River Reduced Width and Inner Confluence Area		
	To -38 feet	To -40 feet	To -42 feet	To -38 feet	To -40 feet	To -42 feet
PROJECT COSTS						
Dredging-Ordinary Material	$1,934,000	$2,606,000	$10,620,000	$3,862,000	$6,525,000	$15,041,000
Ledge Removal	—	2,997,000	8,459,000	1,875,000	2,209,000	5,200,000
Subtotal	$1,934,000	$5,583,000	$19,079,000	$5,737,000	$8,734,000	$20,241,000
Contingencies	484,000	1,396,000	4,770,000	1,435,000	2,183,000	5,060,000
Subtotal	$2,418,000	$6,979,000	$23,849,000	$7,172,000	$10,917,000	$25,301,000
Engineering & Design	102,000	196,000	929,000	211,000	225,000	506,000
Supervision & Administration	215,000	493,000	1,664,000	564,000	767,000	1,771,000
Ship Simulation Studies	250,000	250,000	250,000	250,000	250,000	250,000
Additional Environmental Testing	34,000	34,000	120,000	52,000	52,000	70,000
Construction Cost	$3,019,000	$7,952,000	$26,812,000	$8,249,000	$12,211,000	$27,898,000
Relocation of Navigation Aids	None	None	46,000	4,000	4,000	12,000
SUBTOTAL	$3,019,000	$7,952,000	$26,858,000	$8,253,000	$12,215,000	$27,910,000
Local Berthing Dredging	$ 84,000	$120,000	$169,000	$807,000	$1,002,000	$1,333,000
Utility Relocations	—	—	—	—	—	$2,500,000,000
TOTAL PROJECT COST	$3,103,000	$8,072,000	$27,027,000	$9,060,000	$13,217,000	$2,529,243,000
INTEREST DURING CONSTRUCTION						
Construction Period (Months)	(2)	(6)	(18)	(6)	(9)	(19)
Interest Cost	11,000	144,000	1,705,000	150,000	357,000	1,880,000
ANNUAL CHARGES						
General Navigation Facilities (and Nav. Aids)						
Interest and Amortization						
(8-5/8 percent - 50 years)	$265,600	$709,600	$2,503,500	$736,500	$1,101,900	$2,611,100
Annual Maintenance Dredging	7,300	8,400	32,400	34,000	51,300	106,300
Subtotal	$272,900	$718,000	$2,535,900	$770,500	$1,153,200	$2,717,400
Local Improvements						
Interest and Amortization						
(8-5/8 percent - 50 years)						
Berthing Dredging	$7,400	$10,700	$14,800	$70,700	$87,800	$116,900
Utility Relocations	None	None	None	—	—	$219,125,000
Annual Maintenance Dredging	No increase	No increase	No increase	14,400	19,300	$25,700
Subtotal	$7,400	$10,700	$14,800	$85,100	$107,100	$219,267,600
TOTAL ANNUAL CHARGES	$280,300	$728,700	$2,550,700	$855,600	$1,260,300	$221,985,000
SAY	$280,000	$729,000	$2,551,000	$856,000	$1,260,000	$221,985,000

TABLE 18 (CONTINUED)
BOSTON HARBOR, MASSACHUSETTS
COSTS OF DETAILED PLANS

	D			E		
	Chelsea River Channel			Combined Tributaries Plan		
	To -36 feet	To -38 feet	To -40 feet	All 3 Channels To -38 feet	All 3 Channels To -40 feet	Mystic Reserved to -40 feet Chelsea to -38 feet
PROJECT COSTS						
Dredging-Ordinary Material	$461,000	$2,776,000	$4,466,000	$8,105,000	$13,177,000	$11,413,000
Ledge Removal	---	---	---	1,870,000	4,846,000	4,846,000
Subtotal	$461,000	$2,776,000	$4,466,000	$9,975,000	$18,023,000	$16,259,000
Contingencies	115,000	694,000	1,117,000	2,494,000	4,506,000	4,065,000
Subtotal	$576,000	$3,470,000	$5,583,000	$12,469,000	$22,529,000	$20,324,000
Engineering & Design	104,000	115,000	124,000	311,000	351,000	342,000
Supervision & Administration	117,000	294,000	423,000	957,000	1,570,000	1,435,000
Ship Simulation Studies	100,000	100,000	100,000	600,000	600,000	600,000
Additional Environmental Testing	34,000	34,000	34,000	120,000	120,000	120,000
Construction Cost	$931,000	$4,013,000	$6,264,000	$14,457,000	$25,170,000	$22,821,000
Relocation of Navigation Aids	8,000	8,000	8,000	12,000	12,000	12,000
SUBTOTAL	$939,000	$4,021,000	$6,272,000	$14,469,000	$25,182,000	$22,833,000
Local Berthing Dredging	---	$403,000	$830,000	$1,294,000	$1,954,000	$1,527,000
Utility Relocations	130,000	130,000	4,930,000	130,000	4,930,000	130,000
TOTAL PROJECT COST	$1,069,000	$4,554,000	$12,032,000	$14,893,000	$32,066,000	$24,490,000
INTEREST DURING CONSTRUCTION						
Construction Period (Months)	(1)	(3)	(5)	(10)	(19)	(17)
Interest Cost	2,000	28,000	91,000	329,000	1,107,000	914,000
ANNUAL CHARGES						
General Navigation Facilities (and Nav. Aids)						
Interest and Amortization (8-5/8 percent - 50 years)	$82,500	$354,900	$557,700	$1,297,000	$2,304,200	$2,081,400
Annual Maintenance Dredging	6,500	12,800	18,900	54,100	78,600	72,500
Subtotal	$89,000	$367,700	$576,600	$1,351,100	$2,382,800	$2,153,900
Local Improvements						
Interest and Amortization (8-5/8 percent - 50 years)		$35,300	$72,700	$113,400	$171,200	$133,800
Berthing Dredging	---	11,400	432,100	11,400	432,100	11,400
Utility Relocations	11,400	12,600	17,500	27,000	36,800	31,900
Annual Maintenance Dredging	---	$59,300	$522,300	$151,800	$640,100	$177,100
Subtotal	$11,400					
TOTAL ANNUAL CHARGES	$100,400	$427,000	$1,098,900	$1,502,900	$3,022,900	$2,331,000
SAY	$100,000	$427,000	$1,099,000	$1,503,000	$3,023,000	$2,331,000

TABLE 19
BOSTON HARBOR, MASSACHUSETTS
ANNUAL BENEFITS OF DETAILED PLANS
AND BENEFIT/COST SUMMARY

	Annual Benefits	Annual Costs	Benefit/Cost Ratio	Net Annual Benefits
A. President Roads Ship Channel (nonstructural)	---	---	---	---
B. Reserved Channel Reduced And Confluence Area				
1. To -38 Feet	$1,675,000	$280,000	6.0	$1,395,000
2. To -40 Feet	3,068,000	729,000	4.2	2,339,000
3. To -42 Feet*	3,180,000	2,551,000	1.2	629,000
C. Mystic River Reduced and Inner Confluence Area				
1. To -38 Feet	223,000	856,000	0.3	None
2. To -40 Feet	1,803,000	1,260,000	1.4	543,000
3. To -42 Feet	1,829,000	221,985,000	0.0	None
D. Chelsea River Channel				
1. To -36 Feet	64,000	100,000	0.6	None
2. To -38 Feet	602,000	427,000	1.4	175,000
3. To -40 Feet	1,041,000	1,099,000	0.9	None
E. Combined Tributary Plan				
1. All To -38 Feet	2,500,000	1,503,000	1.7	997,000
2. All To -40 Feet	5,912,000	3,023,000	2.0	2,889,000
3. Chelsea to -38 Mystic and Reserved to -40	5,473,000	2,331,000	2.3	3,142,000

*Note in order to deepen the Reserved Channel to depths greater than 40 feet all seaward access channels must also be deepened.

Comparison Summary

Table 20 provides a summary comparison of the detailed plans. It presents the determinative factors that underlie each final alternative and increment by displaying each alternative's significant beneficial and adverse impacts relative to the projected without-project condition. Each detailed plan and increment thereof is ranked against the without-project condition for each planning objective.

TABLE 20
BOSTON HARBOR, MASSACHUSETTS

SUMMARY COMPARISON OF DETAILED PLANS

	Without Project Condition	A President Roads Channel and Anchorage Nonstructural Realignment	B1-R Reserved Channel Reduced Length Plan To -38 Feet	B2-R Reserved Channel Reduced Length Plan To -40 Feet	C1-R Mystic River Reduced Width and Inner Confluence Area To -38 feet	C2-R Mystic River Reduced Width and Inner Confluence Area To -40 Feet	D2 Chelsea River Channel Entire Length To -38 Feet	D3 Chelsea River Channel Entire Length To -40 Feet	E5 Combined Tributary Plan Reserved and Mystic to -40 Chelsea River to -38 feet
A. Plan Description									
1. General	Maintain existing 35-foot Tributaries 40-foot x 600-foot Main Ship Channel Reserved Channel remains 630 feet wide, with no turning Area	Realign existing navigation buoys at time of next maintenance to mark a 1200-foot wide channel resulting in an increase in anchorage size from 350 to 420 acres	Dredge the 35-foot channel to -38 feet and narrow the channel to 400 feet	Dredge to -40 feet and narrow to 400 feet	Dredge the 35-foot and except southern upstream area Dredge inner confluence to -38 feet	Dredge as in D1 to -40 feet	Dredge the 35-foot Channel and Basin to -38 feet	Dredge as in E1 to -40 feet	Combine plans B2-R, C2-R and D2
2. Excavation									
Ordinary Material	Continue existing Maintenance	None	307,000	438,000	886,800	1,145,000	655,000	770,000	2,038,000
Ledge			None	40,000	32,400	54,000	None	None	94,000
3. Disposal	Maintenance Disposal continues to be at Foul Area	None	Foul Area	Foul Area	Foul Area	Foul Area	Foul Area	Foul Area	Foul Area
4. Local Improvements	Maintain existing berthing depths. Improve Massport container port and break-bulk facilities Widen Chelsea St. Bridge fenders to 96-foot clearance and widen 35-foot Channel to 96 feet.	None	Deepen Berths on Reserved Channel to	Deepen Reserved Channels berths to 40 feet	Deepen Mystic R. berths to 38 feet	Deepen Mystic R. berths to 40 feet	Deepen Chelsea R. berths to 38 feet	Deepen Chelsea R. berths to 40 feet	Deepen Tributary berths to 40 feet at Mystic River and Reserved Channel and 38 feet at Chelsea River
B. Impact Assessment									
1. National Economic Development (NED)									
a. Project First Cost	None	None anticipated	$3,018,000	$7,952,000	$8,249,000	$12,211,000	$4,013,000	$6,264,000	$22,821,000
Navigation Aids	No Increase	Should nav. aids relocation	None	None	4,000	4,000	8,000	8,000	12,000
Local Berthing	None	entail additional costs,	84,000	122,000	807,000	1,002,000	401,000	830,000	1,527,000
Utility Relocations	None	these will be obtained	—	—	—	—	130,000	4,907,000	130,000
TOTAL		from U.S. Coast Guard	$3,100,000	$8,070,000	$9,060,000	$13,220,000	$4,550,000	$12,030,000	$24,490,000

TABLE 20
BOSTON HARBOR, MASSACHUSETTS

SUMMARY COMPARISON OF DETAILED PLANS

	Without Project Condition	A President Roads Channel and Anchorage Nonstructural Realignment	B1-R Reserved Channel Reduced Length Plan To -38 Feet	B2-R Reserved Channel Reduced Length Plan To -40 Feet	C1-R Mystic River Reduced Width and Inner Confluence Area To -38 Feet	C2-R Mystic River Reduced Width and Inner Confluence Area To -40 Feet	D1 Chelsea River Channel Entire Length To -38 Feet	D2 Chelsea River Channel Entire Length To -40 Feet	E5 Combined Tributary Plan Reserved and Mystic to -40 Chelsea River to -38 feet
b. Annual Cost									
Gen. Nav. Fac.	Continued Federal Maintenance of existing projects		$ 265,600	$ 709,600	$ 736,500	$1,101,900	$ 354,900	$ 557,700	$2,081,400
- Amortization			7,300	8,400	34,000	51,300	12,900	18,900	72,500
- OMR			7,400	10,700	85,100	107,100	59,100	522,300	177,100
Berth. & Util.									
Total Annual Cost		None anticipated	$ 280,000	$ 729,000	$ 856,000	$1,260,000	$ 427,000	$1,099,000	$2,331,000
c. Annual Benefits			$1,675,000	$3,068,000	$ 223,000	$1,803,000	$ 908,000	$1,336,000	$5,673,000
d. Net Benefits			$1,395,000	$2,339,000	None	$ 543,000	$ 65,000	$ 481,000	$3,142,000
e. Benefit/Cost Ratio			6.0	4.2	0.3	1.4	1.4	0.9	2.3
2. Environmental Quality									
a. Water Quality	Continued maintenance will cause temporary increases in turbidity	Larger natural deep-water anchorage reduces risk of grounding	Long term decline in sediment released contamination enhanced	Long term decline in sediment released contamination enhanced	Long term decline in sediment released contamination enhanced	Long term decline in sediment released contamination enhanced	Long term decline in sediment released contamination enhanced	Long term decline in sediment released contamination enhanced	Long term decline in sediment released contamination enhanced
	Continued risk of oil spill from future lightering	—	Increased turbidity and reduced dissolved oxygen during construction	Increased turbidity and reduced dissolved oxygen during construction	Increased turbidity and reduced dissolved oxygen during construction	Increased turbidity and reduced dissolved oxygen during construction	Increased turbidity and reduced dissolved oxygen during construction	Increased turbidity and reduced dissolved oxygen during construction	Increased turbidity and reduced dissolved oxygen during construction
	Non-maintenance sediments continue to release contaminants	—			Widening of confluence reduces risk of oil spill	Widening of confluence reduces risk of oil spill			Widening confluence reduces risk of oil spill
b. Air Quality	Continued improvement	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
c. Fishery	Continued maintenance has insignificant effect	No effect	Potential lethal effects from blasting	Same as B1	Same as B1	Same as B1	Same as B1	Same as B1	Same as B1

TABLE 20
BOSTON HARBOR, MASSACHUSETTS

SUMMARY COMPARISON OF DETAILED PLANS

	Without Project Condition	A Presidents Roads Channel and Anchorage Nonstructural Realignment	B1-R Reserved Channel Reduced Length Plan To -38 Feet	B2-R Reserved Channel Reduced Length Plan To -40 Feet	C1-R Mystic River Reduced Width and Inner Confluence Area To -38 Feet	C2-R Mystic River Reduced Width and Inner Confluence Area To -40 Feet	D2 Chelsea River Channel Entire Length To -38 Feet	D3 Chelsea River Channel Entire Length To -40 Feet	E5 Combined Tributary Plan Reserved and Mystic to -40 Chelsea River to -38 feet
d. Benthic	Periodic disruption during maintenance operations	None	Physical destruction of borrowing and immobile species during construction	Physical destruction of borrowing and immobile species during construction	Physical destruction of borrowing and immobile species during construction	Physical destruction of borrowing and immobile species during construction	Physical destruction of borrowing and immobile species during construction	Physical destruction of borrowing and immobile species during construction	Physical destruction of borrowing and immobile species during construction
3. Other Social Effects (OSC)									
a. Noise	No Change	None	Increase during construction	Increase during construction	Increase during construction	Increase during construction	Increase during construction	Increase during construction	Increase during construction
b. Transportation	Continued tidal delay and grounding /collision risk	Larger deep-water anchorage reduces risk of grounding	Reduced tidal delay	Reduced tidal delay	Reduced tidal delay	Reduced tidal delay	Reduced tidal delay	Reduced tidal delay	Reduced tidal delay grounding risk reduced
c. Safety, health, Community well-being	Continued risk of Oil spill and vessel collisions	Larger deep-water anchorage reduces risk of spill	Fewer vessel trips. Reduced	Fewer vessel trips. Reduced spill and vessel collisions	Fewer vessel trips. Reduced risk. Improved vessel safety	Fewer vessel trips. Reduced collision risk	Fewer vessel trips. Reduced collision risk	Fewer vessel trips. Reduced collision risk	Substantially fewer vessel trips. Reduced grounding and spill risk
4. Regional Development (RD)									
a. Income	Continued Growth	No effect	No effect	Same as B1	Same as B1	Same as B1	Same as B1	Same as B1	Same as B1
b. Employment	Continued Growth	No effect	Temporary increase in jobs during construction	Same as B1	Same as B1	Same as B1	Same as B1	Same as B1	Same as B1

TABLE 20
BOSTON HARBOR, MASSACHUSETTS

SUMMARY COMPARISON OF DETAILED PLANS

	Without Project Condition	A President Roads Channel and Anchorage Nonstructural Realignment	B1-R Reserved Channel Reduced Length Plan To -38 Feet	B2-R Reserved Channel Reduced Length Plan To -40 Feet	C1-R Mystic River Reduced Width and Inner Confluence Area To -38 Feet	C2-R Mystic River Reduced Width and Inner Confluence Area To -40 Feet	D2 Chelsea River Channel Entire Length To -38 feet	D3 Chelsea River Channel Entire Length To -40 Feet	E5 Combined Tributary Plan Reserved and Mystic to -40 Chelsea River to -38 feet
c. Business and Industry Activity	No change in deep draft	Potential for growth in receipts	Additional incentive for development because of transportation savings and vessel safety	Same as B1	Same as B1	Same as B1	Same as B1	Same as B1	Same as B1
C. PLAN EVALUATION									
1. Contribution to Solving Problems and Meeting Opportunities									
a. Improve Harbor Safety related to deep draft navigation	Continued risk of grounding	Larger deep-water anchorage reduces grounding risk	Improves safety for Reserved Channel and Main Ship	Increase over B1	Improves safety for Mystic River traffic Improve turning safety in Inner Confluence	Increase over C1	Improves safety for Chelsea River traffic	Increase over D2	Substantial increase in harbor safety
b. Reduce transportation cost for water-bourne commerce	Increased costs as smaller vessels retired	Potential for reduced costs even with increased receipts	Reduced cost for Reserved Channel traffic	Most reduced cost for Reserved Channel traffic	Reduced cost for Mystic River traffic	Most reduced cost for Mystic River	Reduced cost for Chelsea River traffic	Most reduced cost for Chelsea River traffic	Significant reduction for whole harbor

TABLE 20
BOSTON HARBOR, MASSACHUSETTS

SUMMARY COMPARISON OF DETAILED PLANS

	Without Project Condition	A. President Roads Channel and Anchorage Nonstructural Realignment	B1-R Reserved Channel Reduced Length Plan To -38 Feet	B2-R Reserved Channel Reduced Length Plan To -40 Feet	C1-R Mystic River Reduced Width and Inner Confluence Area To -38 Feet	C2-R Mystic River Reduced Width and Inner Confluence Area To -40 Feet	D1 Chelsea River Channel Entire Length To -38 Feet	D2 Chelsea River Channel Entire Length To -40 Feet	E5 Combined Tributary Plan Reserved and Mystic to -40 Chelsea River to -38 feet
c. Contribute to preservation of environmental quality	Continued risk of oil spill	Expanded natural deep-water anchorage reduces grounding risk	Less in benthos short term	Less in benthos benthos short term	Less in benthos short term	Less in benthos short term	Less in benthos short term	Less in benthos short term	Less in benthos short term
d. Improve accessibility to Boston Harbor and maneuverability therein for deep-draft vessels	No affect (may actually be reduced as smaller vessels retired)	Increase in deep-draft anchorage space	Reduced vessel trips to Reserved Channel	Most reduced trips Reserved Channel	Reduced vessel trips Mystic River	Most reduced trips to Mystic River	Reduced vessel trips Chelsea River	Most reduced trips to Chelsea River	Significant reduction in vessel trips in whole harbor
			Improves access and maneuverability to Mystic River traffic	Increase over B1	Improves access and ability to Mystic River traffic	Increase over C1	Improves access and maneuverability for Chelsea River traffic	Increase over D2	Enhances Harbor access and maneuverability for all deep draft traffic
2. Net Effects									
a. National Economic Development (NED)	No Investment No affect	No investment potential for benefit from larger deep-water anchorage	Net benefits $1,395,000	Net benefits $2,339,000	Net benefits None	Net benefits $543,000	Net benefits $175,000	Net benefits None	Net benefits $3,142,000
b. Environmental Quality (EQ)	Continued Improvement	No significant affect	Least tributary dredging	Increased over B1	Most tributary dredging	Increase over C1	Temporary adverse during construction	Increase over D2	Combine B2-R, C2-R and D2
			Less vessel trips to Reserved	Further Decrease	Less vessel trips to Mystic River	Further Decrease	Less vessel trips to Chelsea River	Further Decrease	Less vessel trips entire harbor
c. Other Social Effects (OSC)	No Effect	No significant affect	Positive	Very Positive	Positive	Very Positive	Positive	Very Positive	Most Positive
d. Regional Development (RD)	Increased transportation Costs over time	Provides for greater and deeper-draft traffic volume	Positive	Very Positive	Positive	Very Positive	Positive	Very Positive	Most Positive

TABLE 20
BOSTON HARBOR, MASSACHUSETTS

SUMMARY COMPARISON OF DETAILED PLANS

	Without Project Condition	A President Roads Channel and Anchorage Nonstructural Realignment	B1-R Reserved Channel Reduced Length Plan To -38 Feet	B2-R Reserved Channel Reduced Length Plan To -40 Feet	C1-R Mystic River Reduced Width and Inner Confluence Area To -38 Feet	C2-R Mystic River Reduced Width and Inner Confluence Area To -40 Feet	D2 Chelsea River Channel Entire Length To -38 Feet	D3 Chelsea River Channel Entire Length To -40 Feet	E5 Combined Tributary Plan Reserved and Mystic to -4 Chelsea River to -38 feet
3. Plan Response to									
a. Completeness	N/A	Yes	Yes	Yes	Yes	Yes	No (not without inner confluence)	No (Same as E1)	Yes
b. Effectiveness	No (Reduced)	Yes	Yes	More so than B1	Yes	More so than C1	Yes incrementally	More so than D2	Yes
c. Efficiency	No (Reduced)	Yes, increase in harbor efficiency	marginally	Yes	marginally	Yes	marginally	Yes	Yes (most efficient)
d. Acceptability	Yes	Yes	No	NED Plan for this Channel	No	NED Plan for this Channel	NED Plan for this Channel	No	Overall NED Plan
4. Implementation Responsibility									
a. Design	None	Federal and U.S. Coast Guard	N/A	Federal	N/A	Federal	N/A	Federal	Federal
b. Plans and Specifications	None	None	N/A	Initially all Federal ultimately 35% local	N/A	Initially all Federal ultimately 35% local	N/A	Initially all Federal ultimately 35% local	Initially all Federal ultimately 35% local
c. Construction	None	None	N/A	65% Federal 25% local initial 35% local ultimate	N/A	65% Federal 25% local initial 35% local ultimate	N/A	65% Federal 25% local initial 35% local ultimate	65% Federal 25% local initial 35% local ultimate
d. Maintenance	Continued existing Federal	No increase	N/A	Federal with local provision of disposal site	N/A	Federal with local provision of disposal site	N/A	Federal with local provision of disposal site	Federal with local provision of disposal site

SELECTION OF A PLAN

The selected plan for navigation improvements at Boston Harbor, Massachusetts has been based upon consideration of engineering feasibility, economic efficiency, navigational safety, environmental acceptability and the needs and objectives of local interests as defined earlier. Based on these considerations, the combined tributary plan, with incremental deepening to -40 feet MLW including the nonstructural realignment in President Roads was found to be the overall most favorable plan for meeting the planning objectives.

RATIONALE FOR THE SELECTED PLAN

The Combined Tributary Plan, including the Mystic River Reduced Width Plan and Reserved Channel Reduced Length Plan to depths of -40 feet MLW and the Chelsea River Entire Length Plan to -38 feet MLW, is the selected plan of improvement as it provides the maximum net benefits, contributes significantly to harbor safety and contributes to reducing the potential for adverse environmental impacts associated with increased lightering and the risk of tanker grounding. The same contributions serve to enhance the social well-being of the study area and enhance regional development and the future diversity of port development.

THE SELECTED PLAN

As shown in Figure 33, the project would involve a combination of the three incrementally justified tributary channel improvements.

Specific Federal channel limits would be declared through President Roads from the Outer Confluence of the three entrance channels to the Main Ship Channel, thereby enlarging the President Roads Anchorage by about 70 acres or 20 percent at no cost, as shown earlier in Figure 32.

The Reserved Channel would be narrowed to 400 feet and deepened to -40 feet MLW, with the exception of its upper 1340 feet which would remain at a 35-foot depth. A widened maneuvering area, also deepened to -40 feet MLW would also be located at the confluence of the Reserved Channel, Main Ship Channel and South Boston Drydock Channel, as shown in Figure 34.

The Inner Confluence, which provides access to the Mystic and Chelsea Rivers would be deepended from its present -35 feet to -40 feet MLW and widened along its eastern limit to improve turning safety and improve access to both tributaries. The Mystic River Channel would be deepened from its present -35 feet to -40 feet MLW except for the southern area at the head of the channel from the former Schiavone Wharf upstream to the city playgrounds (Ryan Park). The deepened channel in this upstream area along the northern shore would be 440 feet wide with the remaining width to be left at 35 feet. The selected plan for the Mystic River and Inner Confluence is shown in Figure 35.

The Chelsea River Channel would be deepened in its entirety from its existing -35 feet to -38 feet MLW, as shown in Figure 36.

The selected plan would entail the removal of 2,038,000 cubic yards of ordinary material and 94,000 cubic yards of ledge. The material would be removed by bucket dredge with ocean disposal at the Foul Area.

Total cost of the proposed improvements is $24,490,000. This includes: $22,821,000 for modification of the General Navigation features of the authorized Federal projects; $12,000 for the relocation of navigation aids by the U.S. Coast Guard during construction; deepening of berthing areas at the facilities of the principal beneficiaries estimated at $1,527,000; and costs for relocation of utilities beneath the Chelsea River Channel estimated at $130,000.

For the purpose of benefit/cost analysis, charges for interest during construction amount to $914,000. Annual benefits, outlined previously, accruing to the recommended plan amount to $5,473,000. All benefits are due to a reduction in the value of resources required to transport commodities. These benefits, when compared to annual charges of $2,331,000 (including $166,000 for berthing area deepening and $11,000 for utility relocation) yield $3,142,000 in net annual benefits and a benefit-cost ratio of 2.3.

THE NED PLAN

The selected plan, incorporating improvements to the Reserved Channel with a reduced length at 40 feet, the Inner Confluence and Mystic River with a reduced upper width at 40 feet, and the Chelsea River at 38 feet, is the NED Plan. Each tributary channel was evaluated separately. Incremental depths of 38, 40 and 42 feet were evaluated for both the Mystic River and Reserved Channel improvements. Incremental depths of 36, 38 and 40 feet were evaluated for the Chelsea River Channel improvement. Maximum net annual benefits were achieved at 40 feet, in the case of the Mystic River and Reserved Channel, and at 38 feet in the case of the Chelsea River Channel. Figures 37A, B and C display net annual benefits as a function of incremental channel depth.

CONCLUSIONS

The New England Division, Corps of Engineers, has reviewed and evaluated in the overall public interest, all pertinent data concerning the proposed plan of improvement, as well as the stated views of interested agencies and concerned public relative to the various practical alternatives for providing navigation improvements in Boston Harbor.

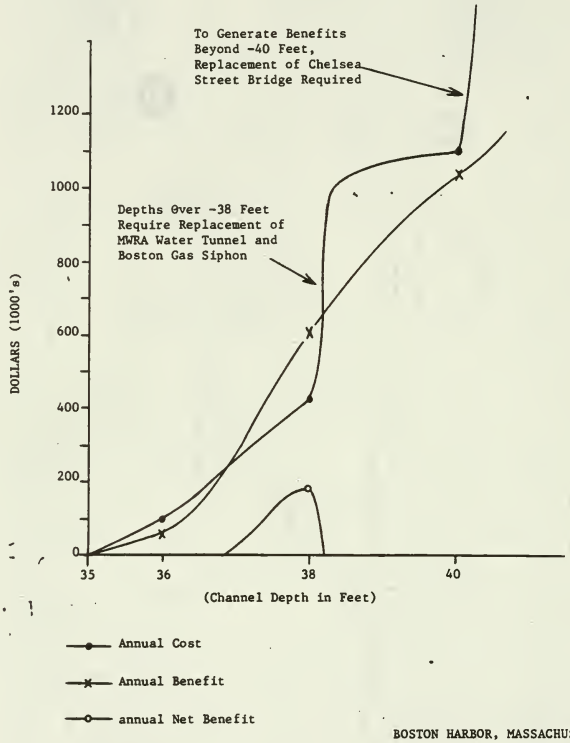
The possible consequences of alternatives have been evaluated on the basis of engineering feasibility, environmental impacts, economic factors of national and regional resource developments, and social well-being of the public.

BOSTON HARBOR
RECOMMENDED PLAN OF IMPROVEMENT
FIGURE 33
MAIN SHIP CHANNEL
CHELSEA RIVER
MYSTIC RIVER
CHARLESTOWN
EAST BOSTON
BOSTON
SOUTH BOSTON
LOGAN AIRPORT
DEER ISLAND
LONG ISLAND
DORCHESTER BAY
GRAPHIC SCALES

GOVERNORS ISLAND
CASTLE ISLAND
PLEASURE BAY
BOSTON
SOUTH
35 MAIN SHIP CHANNEL
40 MAIN SHIP CHANNEL
CONLEY TERMINAL
MASSPORT MARINE TERMINAL
UPSTREAM END OF MARTIAL CHANNEL LENGTH ALTERNATIVE
RECOMMENDED PLAN OF IMPROVEMENT
RESERVED CHANNEL
BOSTON HARBOR, MASS.
GENERAL PLAN

BOSTON HARBOR
MASSACHUSETTS
MYSTIC RIVER
RECOMMENDED PLAN OF IMPROVEMENT
FIGURE 35
CHELSEA
EVERETT
CHARLESTOWN
SOMERVILLE
35' MAIN SHIP CHANNEL
40' MAIN SHIP CHANNEL
CHELSEA RIVER
CHELSEA CREEK
MYSTIC RIVER
MYSTIC AVENUE BRIDGE
MYSTIC RIVER BRIDGE
BOSTON AND MAINE RAILROAD
MYSTIC AVENUE
MAIN STREET
BUNKER HILL MONUMENT
BUNKER HILL COMMUNITY COLLEGE
BOSTON NAVAL SHIPYARD
BOSTON NAVAL SHIPYARD
BOSTON NAVAL SHIPYARD

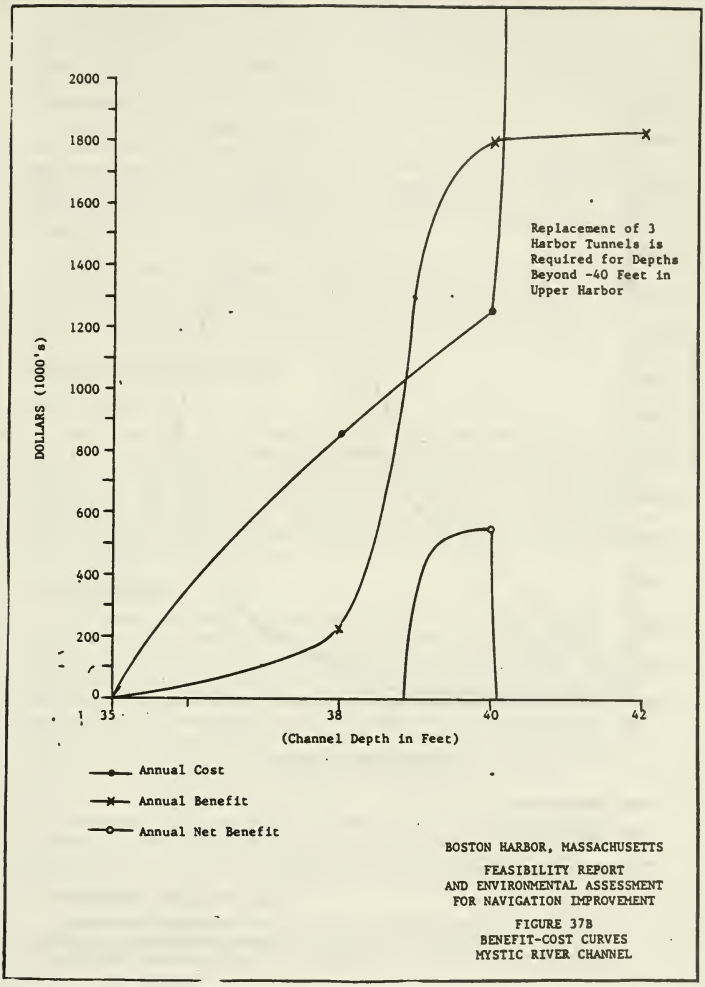
BOSTON HARBOR, MASS
CHELSEA RIVER
RECOMMENDED PLAN
CHELSEA
EAST BOSTON
CHELSEA ST BRIDGE
CHELSEA RIVER
MYSTIC RIVER
CHARLESTOWN
MAIN SHIP CHANNEL
35 FOOT CHANNEL
40 FOOT CHANNEL



BOSTON HARBOR, MASSACHUSETTS

FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT

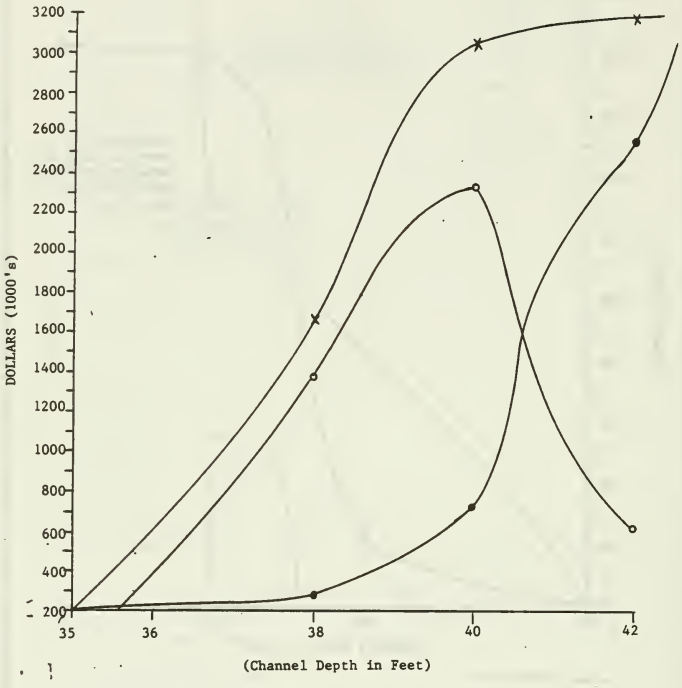
FIGURE 37A
BENEFIT-COST CURVES
CHELSEA RIVER CHANNEL



BOSTON HARBOR, MASSACHUSETTS

FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT

FIGURE 37B
BENEFIT-COST CURVES
MYSTIC RIVER CHANNEL



BOSTON HARBOR, MASSACHUSETTS

FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT

FIGURE 37C
BENEFIT-COST CURVES
SOUTH BOSTON RESERVED CHANNEL

The New England Division finds that substantial benefits are to be derived from providing deeper tributary channels in the Mystic River, Chelsea River, and Reserved Channel. The deepening of the three tributary channels will enhance the benefits of the existing Federal investment in Boston harbor's navigational infrastructure through a reduction in the value of resources required to transport commodities.

Although the proposed improvement would cause disruption of the environment during dredging and disposal operations, these are not considered significant. On that basis, an environmental assessment has been performed in lieu of an environmental impact statement. Additional sampling and testing of sediments would be conducted prior to the preparation of plans and specifications to ensure the ultimate suitability of the dredged materials for ocean disposal.

The selected plan is based on a thorough analysis and evaluation of various practicable alternative courses of action for achieving the stated objectives. The selected plan is consistent with national policy, statutes, and adminstrative directives. This plan would best serve the interests of the general public.

IMPLEMENTATION RESPONSIBILITIES

Cost Allocation

The allocation of first costs for the tentatively selected plan is entirely to the purpose of improving commercial navigation at Boston Harbor. Costs are provided for deepening of the three tributary navigation channels and provision of widened confluence areas. Costs are also estimated for the relocation of navigation aids by the U.S. Coast Guard during and after construction. Local costs for deepening of commercial berthing areas and relocation of utilities are also included. There are no other components of the selected plan.

Cost Apportionment

The Federal and local cost-sharing responsibilities for the first cost of construction and future maintenance of the selected plan are detailed in Table 21, and were prepared according to the provisions of the Water Resources Development Act of 1986 (WRDA). The WRDA specifies that deep-draft navigation improvement projects, such as the selected plan, which involve project depths greater than -20 feet MLW but not greater than -45 feet MLW require a cash contribution during the construction period equal to 25 percent of the cost of construction. Further, payment of an additional 10 percent of the cost of construction, (discounted for locally provided easements, rights of way, disposal areas, etc. as specified), is required over a period of up to 30 years.

Non-Federal interests must also agree to fully fund all required deepening of vessel berthing areas to depths at least commensurate with that of the Federal improvement when such improvement is justified economically on the basis of benefits derived from deeper access to those facilities.

Non-Federal interests must also agree to fully fund all required relocations of utilities required to implement the project. Such relocations are required for the deepening of the Chelsea River Channel only.

Costs for relocation of navigation aids for the project by the U.S. Coast Guard, while included in project costs, are not subject to cost-sharing. Cost apportionment for each of the three separable tributary deepening plans and the selected combined tributary plan are provided in Table 21.

TABLE 21
BOSTON HARBOR, MASSACHUSETTS

COST APPORTIONMENT

PROJECT COSTS	Reserved Channel And Confluence Area to -40 Feet MLW	Mystic River and Inner Confluence to -40 Feet MLW	Chelsea River to -38 Feet MLW	*Combined Tributary Plan
General Navigation Features (GNF)	$7,952,000	$12,211,000	$4,013,000	$22,821,000
Relocation of Navigation Aids	None	4,000	8,000	12,000
SUBTOTAL	$7,952,000	$12,215,000	$4,021,000	$22,833,000
Berthing Deepening	$122,000	$1,002,000	$ 403,000	$1,527,000
Utility Relocations	None	None	130,000	130,000
SUBTOTAL	$122,000	$1,002,000	$ 533,000	$1,657,000
TOTAL COST	$8,074,000	$13,217,000	$4,554,000	$24,490,000
COST APPORTIONMENT				
Federal Cost				
65% of Gen. Nav. Features	$5,169,000	$7,937,000	$2,608,000	$14,834,000
Relocation of Navigation Aids	None	4,000	8,000	12,000
TOTAL	$5,170,000	$7,940,000	$2,620,000	$14,850,000
Non-Federal Cost				
25% of GNF During Construction	$1,988,000	$3,053,000	$1,003,000	$5,710,000
10% of GNF Reimbursed Cost	795,000	1,221,000	401,000	2,280,000
Berthing Area Dredging	122,000	1,002,000	403,000	1,530,000
Utility Relocations	None	None	130,000	130,000
TOTAL	$2,910,000	$5,280,000	$1,940,000	$9,650,000

*Note: Efficiency savings would be realized by combining all three tributary plans, Reserved and Mystic at 40 feet and Chelsea at 38 feet, in one design and construction operation resulting in lower costs.

RECOMMENDATION

I recommend the modification of the existing Federal navigation projects for Boston Harbor, Chelsea River and the Mystic River, Massachusetts, after giving full consideration to all significant aspects of the proposed project, including its engineering feasibility and environmental, social and economic effects, and with such further modifications thereto as in the discretion of the Chief of Engineers may be advisable, as follows:

1) Reduce the 430-foot width of the existing South Boston Reserved Channel to 400 feet, and deauthorize the remaining 15-foot width along each side. Deepen the channel to -40 feet MLW from its existing -35 feet MLW, with the exception of its upper 1340 feet which will remain at -35 feet MLW. Widen the channel to provide maneuvering area at the confluence of the Reserved Channel, Main Ship Channel and Drydock Channel and deepen to -40 feet MLW, relocating the established Harbor Lines accordingly.

2) Deepen the existing 35-foot MLW Inner Confluence Area to -40 feet MLW and widen the area along its eastern limit including a portion of the 35-foot Main Ship Channel to improve the maneuverability of larger vessels as part of the modification described below to improve the Mystic River Channel.

3) Deepen the existing 6570-foot long 35-foot MLW Mystic River Channel 580 feet wide through the Tobin Bridge, 740 to 700 feet wide from the bridge upstream to the Island End River, widening to 930 feet at the Island End River, widening further to 960 feet at the Exxon Terminal then narrowing to 440 feet from Exxon, 3,360 feet upstream to the Boston Edison Terminal to a depth of -40 feet MLW except for that portion along the southern limit from the head of the channel opposite the Charlestown playground, downstream to the former Schiavone Wharf. The width of the channel to be deepened along the northern limit through this upstream reach would be 440 feet. The undredged area would remain at 35 feet.

4) Deepen the existing 35-foot MLW Chelsea River Channel, 200 to 225 feet wide downstream of the Chelsea Street Bridge and 250 to 430 feet wide upstream of the bridge to a depth of -38 feet MLW, widened to the fenders at bridge openings.

5) Designate specific Federal channel limits through President Roads to connect the Entrance Channels at the Outer Confluence with the Main Ship Channel limits, thereby increasing the size of the President Roads Anchorage from 350 to 420 acres and requiring only the relocation of several navigation buoys.

In order to assure realization to project benefits and to aid in final design, I recommend that a Ship Simulation Study be conducted to include the three tributary channels recommended for modification and the Main Ship Channel.

In addition to these modifications to the authorized General Navigation Facilities, local interests would be responsible for relocating utility crossings and the deepening of berthing areas at the terminals of project beneficiaries.

The total first cost of these improvements, estimated at August 1988 price levels is $24,500,000 with a Federal cost of $14,850,000.

This recommendation is subject to the provision that a non-Federal public sponsor agree to all items and provisions required in accordance with the provisions of the Water Resources Development Act of 1986. These provisions include, but are not limited to, the following:

1) A cash contribution equal to 25 percent of the cost of construction of the General Navigation Facilities to be paid during the construction period, presently estimated at $5,710,000.

2) A contribution equal to 10 percent of the cost of construction of the General Navigation Facilities, presently estimated at $2,280,000, discounted for the non-Federal cost associated with providing all necessary lands, easements, and rights-of-way required for construction including suitable dredged material disposal areas with necessary retaining dikes, bulkheads and embankments should they be determined as necessary for initial construction.

3) Provide at non-Federal cost all alterations and relocations as required in sewer, water supply, drainage, gas supply, telephone and electrical supply and other utility facilities, presently estimated at $130,000.

4) Provide for the dredging, at no Federal cost, of all berthing areas of project users identified as beneficiaries of the recommended improvements, to a depth commensurate with that provided by the Federal improvement, presently estimated at $1,530,000.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and/or implementation funding.

COLONEL DANIEL M. WILSON
DIVISION ENGINEER

ACKNOWLEDGEMENT AND IDENTIFICATION OF PERSONNEL

The New England Division is appreciative of the cooperaton and assistance rendered in connection with this study by personnel of other Federal agencies, by State and municipal authorities, the Boston Harbor Pilots Association, and Boston Docking Pilots.

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ENVIRONMENTAL ASSESSMENT AND
FINDING OF NO SIGNIFICANT IMPACT
FOR THE PROPOSED

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Appendix II - Biological Report

Appendic III - Macrobenthic Invertibrate Identifications

Appendix IV - Coordination

I. FINDING OF NO SIGNIFICANT IMPACT

The Environmental Assessment has reviewed all pertinent information regarding the proposed improvement dredging of the Boston Harbor Federal Channels. The proposed project consists of deepening the existing 35-foot deep Boston Harbor Federal channels in the Mystic River, Chelsea River and reserved Channel and vicinity to -38 or -40 feet at Mean Low Water. Additionally, nonstructural realignment of the Federal Channel through President Roads is recommended. The approximately 2.1 million cubic yards of dredged material is proposed to be disposed at the Foul Area Disposal Site.

Environmental impacts associated with this activity include a potential for interference with anadromous fisheries migration, removal of benthic infauna, resuspension of sediments, release of contaminants, and burial during disposal. The proposed mitigation for these impacts include seasonal restrictions for dredging in various channels, use of rock excavated for habitat creation and sequential dredging/disposal to layer or cap contaminants at the point of disposal.

To date, no significant environmental impacts have been identified that warrant preparation of an Environmental Impact Statement. Preliminary evaluation of the project site and planned dredging and disposal activities indicated that there will be no unacceptable environmental impacts.

Since a significant timeframe is required for processing this project through Federal review procedures which would weaken the applicability of the test results for actual project construction impacts, it was decided to delay the bioassay and bioaccumulation testing until advanced engineering and design stages. The tests done at that time can be used to address actual conditions in the project area and guide the project in its selection of final disposal sites and methods.

Additional review and coordination with responsible agencies will occur after bioassay and bioaccumulation tests are performed. I believe this additional coordination period offers an opportunity for all interests to address the actual dredge and disposal site issues at the time of construction.

This assessment has been prepared in accordance with the National Environmental Policy Act of 1969 and all applicable environmental statutes and executive orders. My determination that an Environmental Impact Statement is not required is based upon the information contained in the Environmental Assessment and the following considerations:

a) The project will have no significant adverse effect upon existing water quality in the dredging or disposal areas.

b) A temporary impact will be caused by removal of benthic organisms from the channel by dredging operations, and by burial with deposition of sediments at the disposal site. These organisms will be replaced by recolonization from adjacent areas.

c) Dredging and disposal operations will cause only localized and temporary increases in turbidity and sedimentation.

d) As a result of coordination with the State Historic Preservation Office, it has been determined that no cultural resources will be impacted by the proposed dredging or disposal activity.

e) No significant secondary impacts will be caused by the proposed dredging and disposal.

f) Impacts associated with disposal of the dredged material at the Foul Area Disposal Site will be evaluated using bioassay/bioaccumulation testing prior to construction.

Based on my review and evaluation of the environmental effects as presented in the environmental assessment, I have determined that the proposed deepening of the Mystic River, Chelsea River and Reserved Channels and vicinity, in Boston Harbor, is not a major Federal action significantly affecting the quality of the human environment and is therefore exempt from requirements to prepare an Environmental Impact Statement. This determination is made based on the testing and evaluation process as described in the Environmental Assessment, and with the intent that all pertinent statutes and executive orders will be fully complied with prior to construction.

26 August '88
Date

Thomas A. Rhen
Colonel, Corps of Engineers
Division Engineer

Executive Summary

The proposed project consists of deepening existing 35 foot deep Boston Harbor Federal channels in the Mystic River, Chelsea River and Reserved Channel and vicinity to 38 to 40 feet. Additionally, nonstructural realignment of the Federal Channel through President Roads Anchorage is recommended. Approximately 2.1 million cubic yards of dredged material is proposed to be disposed at the Foul Area Disposal site.

Environmental impacts associated with this activity include a potential for interference with anadromous fisheries migration, removal of benthic infauna, resuspension of sediments, release of contaminants, and burial during disposal. The proposed mitigation for these impacts include seasonal restrictions for dredging, use of rock excavated for habitat creation and sequential dredging/disposal to layer or cap contaminants at the point of disposal.

Testing of the material to be dredged for ocean disposal suitability has been deferred until advanced engineering studies.

Full coordination of this bioassay and bioaccumulation tests will be undertaken to bring this document into compliance with pertinent regulations, as listed. To date, no significant environmental impacts have been identified that warrant preparation of an Environmental Impact Statement and a F.O.N.S.I. is included in Section I.

II Environmental Assessment

A. Introduction

This report is designed to assess the anticipated environmental impacts associated with a proposed improvement dredging project in Boston, Massachusetts. The National Environmental Policy Act (42 U.S.C. 4341 et. seq.) mandates Federal activities to be reviewed with respect to environmental impacts, available alternatives and commitment of resources. The purpose of this Environmental Assessment is to sufficiently review the proposed Boston Harbor improvement dredging project to determine if impacts associated with this Federal action are sufficient to require preparation of an Environmental Impact Statement.

B. Purpose

1. Purpose and Need

The proposed project consists of deepening sections of the existing Federal navigation channel in Boston Harbor (see Figure 1) to 40 feet Mean Low Water (MLW). This dredging will generate approximately 2.1 million cubic yards of material for disposal. The proposed disposal site is the Foul Area, an ocean disposal site in Massachusetts Bay. The

EVERETT
CHELSEA
REVERE
WINTHROP
BOSTON
QUINCY
HULL
LEGEND
BOSTON HARBOR, MASSACHUSETTS
ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT
FIGURE EA-1
PROJECT AREA

proposed dredging would increase the navigational efficiency and safety of Boston Harbor for present types of deep drafted vessels traffic that are currently transiting the project area.

The need for this dredging is evidenced by an economic analysis compiled by the New England Division (NED) Corps of Engineers. This analysis reviewed the selected Net Economic Development Plan and found it to have regional benefits exceeding projected costs (i.e. a BCR >1).

2. Authority

The Army Corps of Engineers is given the authority to conduct General Investigations into improving the navigability of the waters of the U.S. under the River and Harbor Act of 1899. This study was originally initiated at the request of Congressional and local interests, who felt that modifications to Boston Harbor could be justified due to the increase of traffic of bulk commodities flowing through the port, and the delay time being experienced by increasingly larger vessels requiring a high tide to negotiate the existing restricted ship channels into the port. In compliance with the requests of local interests, the Congress of the United States directed the Corps of Engineers to study and report on the present and projected navigation needs in Boston Harbor. Specific authority is contained in two resolutions adopted by the Committee of Public Works of the United States Senate on 1 March 1968 and 11 September 1969. The resolutions request the Board of Engineers for Rivers and Harbors to review the reports of the Chief of Engineers on Boston Harbor, Massachusetts, published as House Document Number 733, Seventy-Ninth Congress, and prior reports, with an intent to determine whether the existing project should be modified. Both resolutions are given in their entirety below:

"RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, That the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act approved June 13, 1902, by, and is hereby requested to review the report of the Chief of Engineers on Boston Harbor, Massachusetts, published as House Document Numbered 733, Seventy-Ninth Congress, and other pertinent reports, with a view to determining the advisability of deepening the existing 35-foot Main Ship Channel, to a depth commensurate with the adjacent 40-foot Main Ship Channel, extending from deep waters in President Roads to the Fish Pier at South Boston, in order to provide overall project dimensions of 40 feet by 1200 feet in this reach of the Main Ship Channel". "RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, That the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby requested to review the report of the Chief of Engineers on Boston Harbor, Massachusetts, published as House Document Numbered 733, Seventy-ninth Congress, and other pertinent reports, with a view to determining whether any modifications of the recommendations contained therein are advisable at

this time with particular reference to modifying the project dimensions of the Main Ship Channel from deep water in Broad Sound to the upstream limit of the Federal project in the Mystic River".

3. Prior Studies and Reports

Boston Harbor has been the subject of numerous reports since 1825, from which time to 1880 projects adopted were intended to preserve the harbor by protecting the surrounding headlands and islands by constructing seawalls, aprons, and jetties. The Broad Sound North Channel, President Roads Anchorage, and Inner Harbor channels were authorized by subsequent Congressional actions. The basis for the existing project can be found as a report in House Document Number 733, Seventy-Ninth Congress and Resolutions adopted by the Committee on Public Works of the United States Senate on 1 March 1968 and 11 September 1969. A list of the reports which have resulted in the present authorized harbor project is presented in section K of this assessment.

C. Proposed Project Description

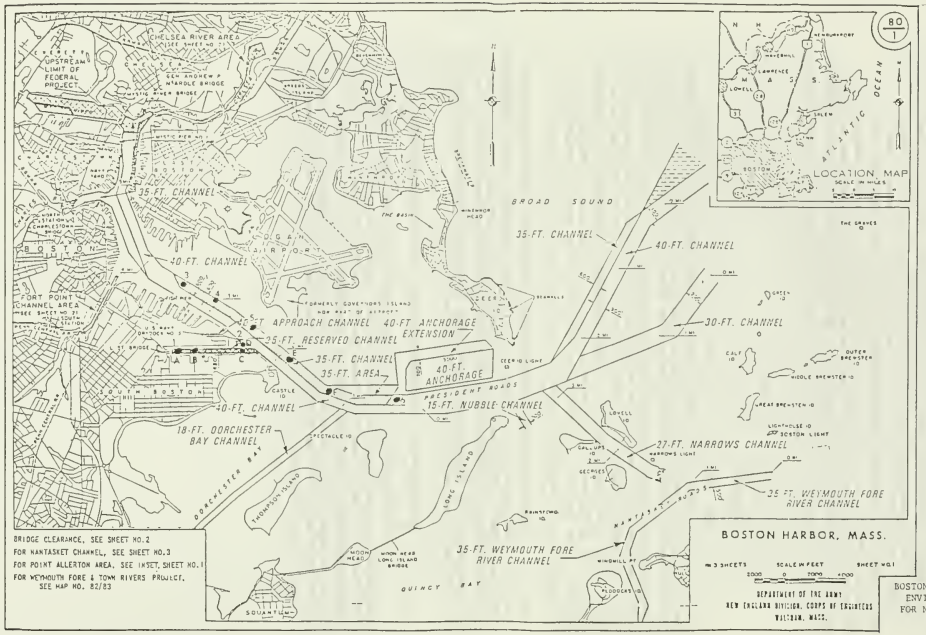
1. Dredging

The tentatively selected project plan would deepen part of the Reserved Channel to 40 feet with the establishment of a small 40-foot deep turning area at the confluence of the Reserved and Main Ship Channels (see Figure 2). Additionally, portions of the existing 35-foot Mystic and Chelsea River channels are proposed to be dredged to a depth of 40 and 38 feet, respectively, and the 35-foot deep confluence of these two upper harbor tributary channels (Inner Confluence) will also be dredged to a depth of 40 feet (see Figure 3). Approximately 2.1 million cubic yards of clay, rock, silt and silty-sand material will be generated from this project. The project is anticipated to require two years of year-round dredging using a mechanical bucket dredge and blasting where necessary.

Concurrent with the deepening of the Federal Channel to -40 feet mlw, local interests are expected to deepen berthing areas associated with the channel. The exact type and quantity of material, the location and its chemical characteristics will be determined prior to construction. The impacts associated with disposal of this material will be analyzed concurrently with the Federal activities.

2. Nonstructural Realignment of the Federal Channel Limits.

The feasibility of enlarging the 40-foot President Roads anchorage was investigated. Jurisdictional limits for the 40-foot Main Ship Channel through President Roads have never been delineated. Such limits would be declared resulting in some additional anchorage area without dredging. The delineation of jurisdictional channel limits would add about 45 acres of new anchorage without cost and will be recommended as part of this project.



Existing -35 feet
Dredge to -40 feet Tributary Channels

Existing Undredged Area
Dredge to -40 feet to form Reserved Channel Turning Area

Existing -35 foot Inbound Main Ship Channel

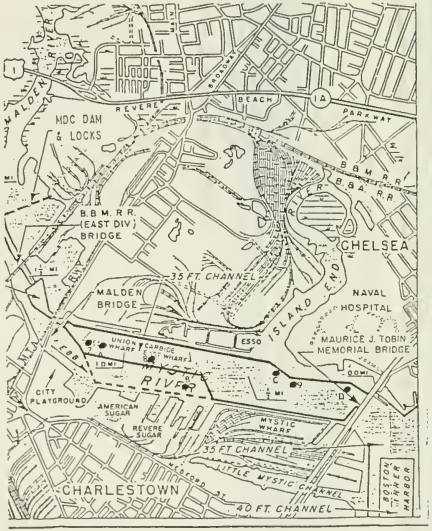
Existing Undredged Area - Finns Ledge

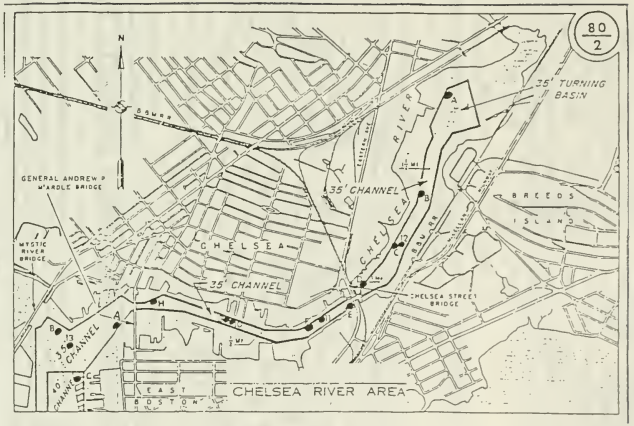
1-6 BENTHIC GRAB SAMPLES
A-F SEDIMENT SAMPLES

BOSTON HARBOR, MASSACHUSETTS
ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT

FIGURE EA-2

DREDGING SITES
RESERVED CHANNEL
AND MAIN SHIP CHANNEL





7-12 _BENTHIC CRAB SAMPLES

A-H SEDIMENT SAMPLES

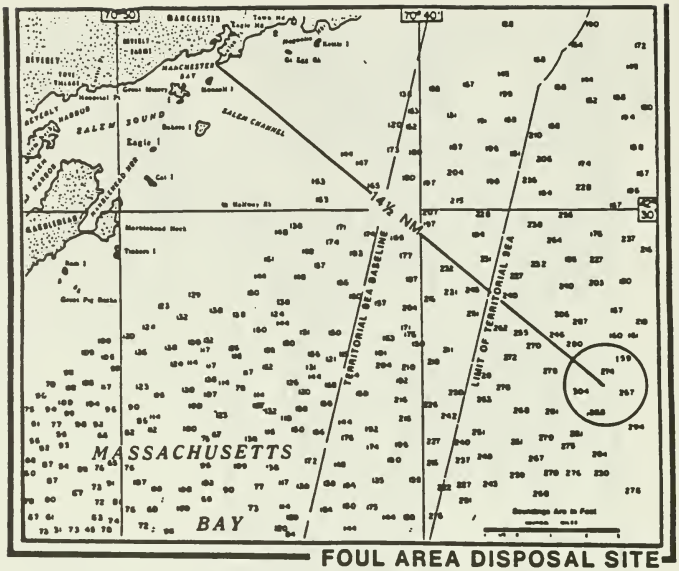
BOSTON HARBOR, MASSACHUSETTS
ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT

FIGURE EA-3

DREDGING SITES
MYSTIC AND CHELSEA RIVERS

30 SEPTEMBER 1985

500 0 1000 2000



FOUL AREA DISPOSAL SITE

Description: This site is a circular area with a diameter of 2 nautical miles and center at 42°-25.7'N. 70°-34.0'W. From the center, the Marblehead Tower bears true 282° at 24,300 yards and Baker Island Horn bears true 300° at 24,300 yards. The authorized disposal point (within the overall disposal area) is specified for each dredging project in other project documents. Depth Range: 159 to 304 feet MLW.

NOTE: The map depicts the disposal site's location in relation to landmarks. It is not intended for use in navigation.

BOSTON HARBOR, MASSACHUSETTS
ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT

FIGURE EA-4

THE FOUL AREA DISPOSAL SITE

3. Disposal

The dredged material is proposed to be disposed at the Foul Area Disposal Site (see Figure 4). A clamshell bucket dredge will load the excavated material onto barges to be transported to the Foul Area Disposal Site (FADS). This disposal would total approximately 2.1 million cubic yards of material and require approximately 1500 barge trips. The project will take approximately 17 months to complete with disposal continuing year-round.

D. Alternatives

1. No Action Alternative

The no action alternative would allow the Boston Harbor Federal Channels to remain in their existing configurations. This alternative precludes the regional economic benefits of the proposed project and therefore is not the recommended plan. The without project condition would be analogous to the existing project, as shown on Figure 1, consisting of three main entrance channels, 27, 30 and 35/40 feet deep converging at the Outer Confluence in President Roads. A 40 foot 353 acre anchorage and a 35 foot deep Inner Confluence Area existing at the mouths of the Mystic and Chelsea Rivers. Up to East Boston this Main Ship Channel has two 600 foot lanes. The inbound lane is 35 feet deep and the outbound lane is 40 feet deep. The 40 foot depth continues upstream at an average width of 700 feet to the Inner Confluence Area at the mouths of the Mystic and Chelsea Rivers. Up to East Boston this Main Ship Channel has two 600 foot lanes. The inbound lane is 35 feet deep and the outbound lane is 40 feet deep. The 40 foot depth continues upstream at an average width of 700 feet to the Inner Confluence. Three active deep draft tributary channels, the Reserved Channel, Mystic River and Chelsea River are provided with 35 foot depth. The existing 18 foot Dorchester Bay channel was authorized for deepening to 35 feet but remains unconstructed and is not included in this study. The 15 foot Nubble Channel, 40 foot South Boston Drydock Channel, 35 foot Charles River Channel, 35 foot Charlestown Waterfront Channel, 35 foot Downtown Boston Waterfront Channel, 27 foot Fort Point Channel, 30 foot Broad Sound South Entrance Channel and 27 foot Narrows Entrance Channel are also not included in this study.

2. Modification of Proposed Dredging

Over the past decade various dredging alternatives have been investigated for their economic and environmental implications while fulfilling the project intent. In keeping within the scope for the study authorization, the immediate and future navigational needs for deep draft vessel movement in Boston Harbor were investigated relating to the following proposed harbor modifications:

- Finns Ledge - The feasibility of removing a portion of Finns Ledge in the outer harbor, thereby straightening the Broad Sound North Entrance Channel was examined in response to concerns raised by the Boston Harbor Pilots Association. Insufficient benefits were identified to justify the cost of such an effort.

- Broad Sound North Channel Widening - The existing 900-foot width of the 40 foot channel and 600 foot width of the 35 foot channel are considered sufficient to allow two way traffic for existing traffic volume.

- Inbound Main Ship Channel Deepening - The existing project provides for two 600-foot wide travel lanes in the Inner Harbor's Main Ship Channel in the reaches between President Roads and East Boston. The inbound lane is 35 feet deep and the outbound lane is 40 feet deep. Local harbor interests and specifically the 1968 resolution directed examination of deepening all or a portion of the 35 foot inbound channel to 40 feet. The improvement examined in the 1979 Draft Feasibility Report proposed deepening a 400-foot wide portion of this inbound lane to provide a full 1000-foot wide 40 foot channel thus accommodating two way traffic at a uniform depth. The remaining 200-foot width of the 35 foot channel would be retained to provide an additional lane for shallower draft vessels calling at the Bird Island Container port. Economic benefits generated by existing traffic volumes and vessel sizes do not result in sufficient justification for this improvement.

- President Roads Anchorage Enlargement - The existing project provides for an anchorage 40 feet deep over 353 acres in the outer harbor. A smaller 68 acre, 35 foot deep, 800-foot wide anchorage adjoins the Inbound Main Ship Channel along its first 3,700 feet. The feasibility of enlarging the 40 foot anchorage was investigated. Dredging of additional area, principally to the northeast was examined. However, expansion of the anchorage through additional dredging did not prove to be economically justified.

- Project Deepening Beyond 40 feet - The feasibility of deepening portions of the project beyond 40 feet has been examined. The 3 existing Boston Harbor Tunnel, particularly the MBTA tunnel, preclude deepening beyond the existing 40 feet in areas above the tunnel crossings. Differing wave climates would require an additional one-foot of safe clearance in the Outer Harbor (President Roads and Broad Sound North Channel) over the Inner Harbor (Main Ship Channel From President Roads to East Boston and Reserved Channel). Therefore 42- and 44-foot Inner Harbor depths were examined in conjunction with 43- and 45-foot Outer Harbor depths, respectively. At this time, it appears that such major deepening improvements are not economically justifiable.

The proposed project, as previously described, represents the preferred and most feasible alternative that fulfills the legislative intent.

3. Modification of Proposed Disposal

The only practical alternative for disposal is at the Foul Area Disposal Site. Sasaki and Associates (1983) have conducted an extensive survey of the Boston Harbor area for disposal site alternatives (upland, containments, etc.). This report indicates three upland sites available in the vicinity of the proposed dredging project (that do not require intertidal fill). These sites are 0.7 acres along the south side of the Charles River and three acres west of Dorchester Avenue and privately owned (Monsanto) areas along the Mystic River (Sasaki & Associates, 1983). After review of environmental and economic feasibility, using nine siting criteria developed for the office of Coastal Zone Management, these sites are not considered viable. The Monsanto sites are not available according to the report. One site is currently in the area of the proposed Third Harbor Tunnel project for airport access and although it is capable of retaining 85,000 cubic yards, it is not currently available for other project uses. The only other upland site identified in the Sasaki (1983) report is capable of retaining 13,500 cubic yards. This small site is also identified as non-viable by the report for environmental concerns, economic constraints, and poor accessability (through Charles River locks). Some of the dredged material may be suitable for construction fill or artificial reef development. If non-Federal interests identify a willingness to pay for these alternatives, they will be considered.

The Commonwealth of Massachusetts is currently assessing the viability of creating containment site for disposal of contaminated dredged material in Boston Harbor. If this site was available and the dredged material from this project was determined unsuitable for ocean disposal, use of this site would be investigated.

The most practical alternative is ocean disposal at the Foul Area Disposal Site. This ocean disposal site is being extensively monitored and managed by the Corps of Engineers to meet the dredged material disposal needs of the greater Boston region. Environmentally this site is the preferred alternative since it is a previously impacted area that currently receives approximately 300,000 cubic yards of dredged material annually (NED, unpublished). The rock can be disposed on the rock/cobble substrate, in the northeast quadrant of FADS, to create a reef habitat. The fine-grained material can be isolated in the western sectors where currents are quiescent.

E. Affected Environment

1. Dredging Site

a. General

Boston Harbor is located on the coast of Massachusetts between Cape Cod and the New Hampshire border (see inset Figure 1). The harbor is formed by a group of outlying islands and the peninsula areas of

Winthrop and Hull. The harbor is the largest port in the New England region, covering approximately a 47-square-mile area. It supports shipping, commercial, industrial, fishing and recreational interests.

b. Physical and Chemical Environment

The dominant currents in the harbor are tidal in origin, although wind driven currents occur during storms. Freshwater flow discharges from the Mystic, Charles, and Chelsea Rivers generally overlie the more dense seawater flows from the tides. Freshwater flows average 350 to 500 cubic feet per second (cfs) in the summer. Tidal input are orders of magnitude greater with flows averaging 320,000 cfs for a 6 hour period and volumes ranging from 10.6 billion gallons at low tide to 179.9 billion gallons at high tide (Metcalf and Eddy, 1976 and MDWPC, 1986). Approximately 73.3 billion gallons are exchanged through three channels linked with the President Roads area and one channel linked with Nantasket Roads. Also input into this system is 500 million gallons per day of freshwater and waste outflow from the Boston regional wastewater treatment plants.

The average tidal range in Boston Harbor is 9.5 feet with spring tidal ranges often in excess of 11.0 feet. Average current velocities for the Inner Harbor are less than 0.5 knots. Velocities in other portions of the harbor are generally less than 2.0 knots, with the exception of restricted passages such as between Peddocks Island and Hull where the maximum predicted velocities are in excess of 2.5 knots. Maximum current velocities during spring tide at the areas to be dredged are as follows: 0.1 knots in the Mystic River, 0.2 knots in the Chelsea Rivers and 0.7 knots in the Mainship Channel vicinity (N.O.A.A., 1986).

The quality of water in Boston Harbor has been the target of considerable expenditures of Federal, State and private funds. Historically, the main contributors of water pollution in the harbor have been raw sewage discharges, combined sewage overflows (CSO's), partial waste treatment and sludge discharges, industrial discharges, urban runoff, oil spills, and poor quality of tributary streams. For the most part, the raw sewage and straight industrial discharges are being rectified as well as present funding and facilities will permit. The present discharge of partially treated sewage and sewage sludges and the CSO's remain the largest water quality problem in the harbor. The history of contamination is found in the harbor sediments which are discussed below.

In general, the water quality of Boston Harbor increases from inner harbor seaward. The harbor areas that are planned to be dredged are all classified as SC waters. Such waters are classified as suitable for aesthetic enjoyment, recreational boating, industrial cooling and process use, and as habitat for indigenous wildlife and forage for game fish. The Outer Harbor areas, except for Broad Sound Channels, are classified SB waters. The classification of SB implies suitability for aesthetic enjoyment, habitat for indigenous wildlife and forage and game fish, and the harvesting of shellfish with depuration. The waters in the Broad Sound

areas are classified as SA. This classification implies excellent suitability for primary contact sports, excellent fish and wildlife habitat, and possible approval for shellfish harvesting with depuration.

Water quality in Boston Harbor has been found to vary both spatially and temporally. The data contained in Table 1 is in general a seasonal summary of previously available data. A more recent data set for June through October 1985 (MDWPC, 1986) is also within the ranges listed on this summary table.

Barring any localized effects around thermal outfalls from power generating stations, the temperature regime in the harbor is under normal climatic and estuarine controls. The enrichment level in the Outer Harbor is generally considered to be at a mesotrophic scale without excessive primary production (National Commission on Water Quality, 1976). The Inner Harbor is also enriched from combined sewer outflows and the high level of nutrients in the river system feeding the harbor.

Dissolved oxygen levels at many locations of the Inner Harbor have been impacted by the basic water quality and primary production, while in the Outer Harbor the oxygen levels have been found to be more dependent on primary production (New England Aquarium, 1973). Vertically averaged 1986 dissolved oxygen levels (MDWPC, 1986) exhibit low value ranging as low as 4.5 ppm in the project area. These values represent summer biological activity in conjunction with organic enrichment of the ecosystem. Oxygen depletion is a significant problem in many estuaries during times of thermal stratification of the water column. The strengthening and deepening of the water column thermocline limits the circulation and oxygen exchange in the nearbottom waters. As temperatures peak (often in August), available dissolved oxygen levels depress and cause a corresponding depression in biological activity at the sediment water interface. This "August Effect", as it commonly referenced, is a major environmental factor in structuring biological communities in the project area. Data obtained by the Massachusetts Division of Water Pollution Control (in press, personal communication - Mr. Christopher C. Sholl, 1987) identify biweekly data points in the project area in 1986 ranging from 4.7 to 3.3 ppm from June to August in the Mystic River. Other harbor areas had dissolved oxygen levels as low as 1.1 ppm in early August. This oxygen depletion contributes to a significant faunal depletion on a cyclic basis as discussed in the Biological Environment section of this report. The water chemistry of the project area, in particular the organic load and its subsequent chemical oxygen demand, is a significant factor in the ecology of Boston Harbor.

Salinity data indicate the Outer Harbor is well mixed, while the various regions of the Inner Harbor are under the influence of freshwater inputs. Essentially, the mouth of the harbor is considered stenohaline and the Inner and Outer Harbor areas are euryhaline. Oil pollution has created problems in many harbor areas and a permanent oil boom is maintained at the mouth of Chelsea Creek to protect the remainder of the harbor from potential spills in the main tanker terminal area.

Table 1. Water Quality Data, Boston Harbor[1]

Parameters[2]	River Complex	Outer Harbor	Outside Harbor
Temperature °C.	0-21	0-22	0-20.5
Salinity ‰	4-32	21-34	28-34
Chemical[2]			
D.O., ppm	2.41-11.49	6.02-14.0	6.48-12.65
Nitrogen mg/l			
Ammonia - N	0.01-1.0	0.01-14.0	0.01-0.40
Nitrate - N	0.22-1.24	.001-.570	0.002-.940
Phosphorus mg/l			
Total	0.05-1.02	.024-1.33	0.010-.133
Ortho	.007-.924	.010-1.17	0.018-.082
Zinc[3] ppb	30.6-62.2	7.8-16.7	
Copper[3] ppb	2.8-6.6	1.9-8.6	
Lead[3] ppb	2.2-10.6	1.2-2.7	
Nickel[3] ppb	7.2-13.6	0.1-13.6	
Chromium[3] ppb	0.2-3.69	0.1-1.2	
Cadmium[3] ppb	0.34-0.56	0.11-1.10	
Biological[2]			
Bacterial cts. (coliform)	0-96,000	0-10,000	0-4,200

(1) Table from Jason Cortell Associates (1977)
(2) New England Aquarium (1973)
(3) New England Aquarium (1972) (values are for soluble phase)
N.B.: Recent sampling by MDWPC (1986) is within the described ranges, but not averaged here is since it only occurred June through October.

The bacterial quality of the harbor waters have been extensively investigated. There are many areas in the Inner and Outer Harbors which are considered grossly contaminated; and, in spite of the water classifications, the harvesting of shellfish is prohibited. The general densities of total coliform bacteria are indicated in Table 2 and MDWPC, 1986. The inputs of bacteria are principally attributable to the CSO's (combined sewer overflow) and those bacteria surviving treatment plant chlorination. High levels of bacteria have been found in the rivers which drain into the harbor, but the sources have never been documented. It is not unusual for the swimming beaches to be closed following a storm of moderate duration and intensity due to bacterial contamination from the CSO's.

Levels of trace metals in the Inner harbor have been related to the sewage discharges, CSO's, urban runoff, and the metals contributed by the major rivers. Dorchester Bay has been found to contain the least

amount of waterborne trace metals, with the principal source in its inner portion being the Neponset River (New England Aquarium, 1972). In the Outer Harbor, higher levels of metals have been found around the sewage outfalls. The State analyses of outfall effluent has identified hundreds of million gallons per day (MGD) containing various levels of contaminants listed in Table 2 except for Cd, Ni, Ag and As. Lead discharges, for example, ranged from 0.04 ppm to 0.28 ppm in the 1986 effluent sampling. This multiplied by a conservative volume of 100 MGD yields a daily discharge of 4 to 28 gallons of lead in solution. These discharges combined with riverine and direct urban runoff represent a significant degradation of the Boston Harbor water quality. A comparison of the MDWPC (1986) inner harbor water column data demonstrates the ambient concentrations of lead, copper, cadmium and occasionally zinc exceed EPA (1985) water quality criteria. Various processes of flocculation and adsorption of the contaminants into the substrate produce corresponding elevations in sediment chemistry.

Sediments in Boston Harbor or predominantly glacial materials with the organic fraction of the sediments resulting from industrial and sewage discharges into the harbor. The most prevalent harbor sediment is a plastic clay of glacial origin, know locally as the Boston blue clay. This layer has been detected throughout the harbor in various seismic investigations (Edgerton, 1963 and 1965). The clay is often overlain by more recent sediments, including coarser silts and sands that serve as repositories for contaminant associated particulates. In several areas, finer grained recent sediments contain considerable quantities of gas, predominantly CO_2, CH_4, and H_2S. Sasaki Associates (1983) summarize the chemical characteristics of the harbor sediments based on studies by the Corps of Engineers, Massachusetts Division of Water Pollution Control, the New England Aquarium and other private groups. The levels of contaminants vary throughout the harbor predominantly depending on hydrology and substrate type. In general, contaminant levels are relatively high in the Inner Harbor and decrease seaward.

Table 2 summarizes the results of a 1986 NED sampling effort that collected twenty-one (21) sediment samples from various areas proposed to be dredged. Appendix I contains the actual values for the chemical constituents measured. The following discussion of sediment chemistry deals with surface sediment overburden, generally the upper 30 centimeters (0.3 meters) of substrate. Dredging will remove substrate to approximately 1.5 meters which will also be removing pristine lean clays. This material (see Mystic River Station C data) has not been exposed to contamination since previously channel depths were maintained to 35 feet. A conservative estimate of the ratio of recent (i.e. contaminated) sediment to pristine lean clay and rock is 20% recent to 80% lean clay (i.e. 0.3 to 1.5 meters of strata. See corin data, Appendix I). Using the estimated 2.1 million cubic yards of material to be dredged, 1.7 million cubic yards can be expected to be pristine clays and rock. The remaining 0.4 million cubic yards will have a chemical signature as described below.

Table 2. Summary of Chemical Analysis for Boston Harbor Sediment Samples (March - April 1986).

Location	Physical Description	% Fines	Oil/Grease (ppm)	Heavy Metals I	II	III	PCB (ppb)
Mystic River:							
A	Organic Clay	90	4300 (II)	3	3	3 (Pb, As, V)	
B	Organic Clay	87	4400-5300 (II)	1	4	4 (Pb, Zn, As, V)	3000 (III)
C	Lean Clay	95	53	9	0	0	
D	Clayey Sand	33	1000 (II)	8	1	0	
Chelsea River:							
A	Organic Clay	68	2200 (II)	5	4	0	
B	Organic Clay	65	1200 (I)	8	1	0	
C	Clayey Sand	14	1400 (I)	6	3	0	
D	Organic Clay	75	3300 (II)	5	3	1 (Pb)	
E	Organic Clay	60	4100 (II)	6	3	0	
F	Organic Clay	40	1000 (I)	6	3	0	240 (I)
G	Organic Clay/ Clayey Sand	42	2100 (II)	5	3	1 (Pb)	
H	Organic Clay	50	1300 (I)	7	2	0	
Inner Confluence:							
A	Clayey Sand	18	1000 (I)	7	2	0	
B	Clayey Sand	45	830 (I)	6	3	0	170 (I)
C	Organic Clay	77	1500 (I)	5	3	1 (Pb)	
Reserved Channel:							
A	Organic Clay/ Lean Clay	90/100	6300 (II)	4	4	1 (Pb)	
B	Organic Clay/ Lean Clay	62/96	590 (I)	7	2	0	770 (II)
C	Organic Clay	77	710 (I)	7	2	0	
D	Organic Clay	95	3200 (II)	7	2	0	
Main Ship Channel:							
E	Organic Clay	88	1400 (I)	7	2	0	
F	Organic Clay	85	1300 (I)	7	2	0	
Broad Sound North Channel (1978):							
GE-8	Gravel	0.6	--				
GE-9	Sandy Gravel	1.8	--				
GE-10	Sandy Gravel	5.0	1700 (I)	9	0	0	
GE-11	Gravelly Sand	2.7	--				

I Category One - State of Massachusetts Classification of Dredge or Fill Material
II Category Two - State of Massachusetts Classification of Dredge or Fill Material
III Category Three - State of Massachusetts Classification of Dredge or Fill Material

Each of the 21 sediment sampling stations were analyzed for dominant soil classification, grain size, liquid and plastic limits, specific gravity and percent of solids, pH, volatile solids, chemical oxygen demand, oil and grease, mercury (Hg), lead (Pb), Zinc (Zn), arsenic (As), barium (Ba), cadmium (Cd), chromium (Cr), copper (Cu), berryllium (Be), nickel (Ni), silver (Ag), manganese (Mn), vanadium (V) % carbon, % hydrogen, % nitrogen, DDT (Dichloro-diphenyl-trichloro-ethane) and polychlorinated biphenyl compounds (PCB) (Table 2).

The dredging and disposal of materials from Boston Harbor will elutriate loosely adsorbed chemicals and impart a chemical signature in the sediments at the disposal site. To assess these impacts New England Division performed various physical and chemical test in March and April 1986 on the proposed dredging sites.

Physical analyses include a visual classification of the sediments and determinations of grain size including specific gravity of solids and percent solids to identify the silt, clay and/or sand content of the material. Percent volatile solids approximate the amount of organic matter present in the solid fraction of the sample. Chemical oxygen demand is a measure of the oxygen required (consumed) to oxidize all organic matter in the substrate sample. Oil and grease measurements determine the sample concentration of biological lipids and mineral hydrocarbons (soluable in trichlorotrifluoroethane). Various metals analyzed include mercury (organic and inorganic salts); lead from industrial, mine or smelter discharges; zinc from corrosion of galvanized iron and brass and industrial waste; arsenic from mineral dissolution, industrial discharges or insecticide applications; barium from industrial processes; cadmium from deterioration of galvanized pipe or industrial discharges; chromium from industrial wastes (salts) and from corrosion control (chromate compounds) in cooling waters; copper from industrial use and applications as a biological control; beryllium from chemical reactions and aviation fuels; nickel from industrial processes and alloy corrosion; silver from industrial processes and bactericidal applications; manganese from domestic wastewater, industrial effluents and receiving streams; and vanadium from dyes, ceramics, inks, and catalyst manufacturing. Percent carbon (total organic carbon), hydrogen and nitrogen are indicative of the organic state of the substrate (see also chemical oxygen demand). PAH (Polycylic Aromatic Hydrocarbons) and PCB (Polychlorinated Biphenyl Compounds) testing was not performed at all sites. These analyses will be conducted in conjunction with the tiered bioassay/bioaccumulation procedure as described in Section F. Environmental Consequences. Where analyzed, PCB data is discussed below.

Mystic River

An estimated 645,000 cubic yards of material will be removed from the Mystic River Channel, including blasting and removal of approximately 6,000 cubic yards of rock. Chemical sampling was conducted at four (4) stations: A through D (see Figure 3).

Station A sediments were found to be black organic clay with a high oxygen demand (204,000 ppm) and 90% fines with high (Class III) levels of volatile solids (13.27%); lead (213 ppm); arsenic (21.7 ppm) and vanadium (300 ppm). Moderate (Class II) levels of oil and grease (4300 psm); mercury (0.69 ppm); and zinc (242 ppm) were present. All other constituents were in low concentration.

Station B was found to be black organic clay with a moderate chemical oxygen demand (134,000 ppm) and 89% fine grained material. Elevated levels of lead (342 ppm); zinc (435 ppm); vanadium (240 ppm) and PCB (3.0 ppm) were present. Moderate levels of volatile solids (8.46 ppm); oil and grease (5300 ppm); mercury (1.35 ppm); arsenic (11.7 ppm); chromium (180 ppm); copper (218 ppm); and nickel (75 ppm) were present. All other constituents were in low concentrations.

Station C was determined to be dark olive gray lean clay with a low chemical oxygen demand (<1000 ppb) and 95% fine grained. No elevated levels of contaminants were found in this material.

Station D was found to be dark olive gray clayey sand with gravel, with a low chemical oxygen demand (50,800 ppm) and comprised of 33% fine grained material. A moderate level of mercury (0.53 ppm) was the only contaminant present.

In summary, the Mystic River sediments are predominantly fine grained organic clay materials in the western reach (station A & B), pristine clay (Station C) and clayey sand (Station D) toward the eastern sector. Elevated levels of PCB, volatile solids, lead, arsenic, zinc and vanadium and moderate levels of oil and grease, mercury, copper, chromium and nickel are present in the western fine grained materials (Station A & B). The eastern section of the channel is relatively uncontaminated with moderate levels of mercury, oil and grease at Station D.

Chelsea River

The proposed channel improvement dredging in the Chelsea River will remove approximately 455,000 cubic yards of material. Chemical sampling was conducted at eight (8) stations (A through H). PCBs were analyzed at Station B and F, and were found to be in low (240 ppm) concentrations at each station.

Station A, in the northeastern most section of the river was found to be predominantly sandy organic clay with a low chemical oxygen demand (43,500 ppm) and 68% fine grained material. There were no high (Class III) contaminant concentrations found in this sample. Moderate levels of oil and grease (2200 ppm); mercury (0.61 ppm); lead (158 ppm); chromium (160 ppm); and nickel (64 ppm) existed at this station. All other contaminants were present in low or less than detectable amounts.

Station B, in the Chelsea River region, was predominantly sandy organic clay with moderate oxygen demand (132,000) from its 65% fine grained sediments. All contaminant concentrations were low or less than detectable except for the moderate (Class II) chromium concentration of 138 ppm.

Station C was predominantly clayey sand, 14% fine grained material with a low dissolved oxygen demand (35,600 ppm). No contaminants were present in high (Class III) concentrations. Moderate (Class II) levels of lead (124 ppm); chromium (146 ppm); and nickel (66 ppm) were found at this station.

Station D was predominantly organic clay with sand, 75% fine grained material with a moderate chemical oxygen demand (122,000 ppm). Elevated levels of lead (262 ppm) existed. Moderate levels oil and grease (3,300 ppm); mercury (0.53 ppm); zinc (215 ppm); and chromium (142 ppm) were present.

Station E was predominantly sandy organic clay; 60% fine grained material and had a low chemical oxygen demand (60,800 ppm). No contaminants were present in high concentrations. Moderate levels of oil and grease (4,100 ppm); mercury (1.16 ppm); lead (179 ppm); and chromium (134 ppm) were present.

Station F was clayey sand and 40% fines with a low chemical oxygen demand (68,700). High (Class III) levels of contaminant were not detected. Moderate (Class II) levels of mercury (0.61 ppm); lead (125 ppm); and nickel (56 ppm) were present.

Station G was sandy organic clay and composed of 68% fine grained material with a moderate chemical oxygen demand (102,000 ppm). The only contaminant detected in high concentrations was lead at 283 ppm. Moderate levels of mercury (1.14 ppm); zinc (276 ppm); and chromium (185 ppm) were present.

Station H was predominantly sandy organic clay, 50% fine grained and imparted a low chemical oxygen demand (41,500 ppm). Moderate levels of mercury (0.88 ppm) and lead (122 ppm) were the only contaminants detected.

In summary, the Chelsea River sediments contained elevated levels of contaminants (lead) at only two of the eight stations sampled. In general, moderate levels of oil and grease, mercury, zinc, lead, chromium and copper were found at some stations. All other contaminants were low or below detectable concentrations.

Inner Confluence

The Inner Confluence area was sampled at three stations (A, B, and C) for physical and chemical parameters. PCB analysis was performed

on material from Station B and found to be a low (Class I) concentration at 0.17 ppm. Station C lies slightly outside the presently proposed dredging footprint, (see Figure 3), but can be expected to represent the sediment quality in the southern Inner Confluence area. The estimated dredging volume includes 48,000 cubic yards of rock and 506,000 cubic yards of clay, silt and sand for a total estimated volume of 554,000 cubic yards.

Station A was predominantly clayey sand with gravel having 18% fine grained material in the sample, with a low chemical oxygen demand (20,600 ppm). No high (Class III) chemical concentrations were present. Moderate (Class II) levels of mercury (0.59 ppm) and lead (182 ppm) were present. All other contaminants were present in low (Class I) concentrations or were below the instrument detection limits.

Station B was predominantly clayey sand, 45% fines with a moderate chemical oxygen demand (78,200 ppm). No high (Class III) contaminant levels were detected. Moderate levels of mercury (1.06 ppm); lead (138 ppm); and nickel (65 ppm) were present.

Station C was predominantly organic clay with 77% fines and a moderate chemical oxygen demand (91,000 ppm). Lead was the only elevated contaminant present (273 ppm). Moderate levels of mercury (0.74 ppm); zinc (258 ppm) and chromium (143 ppm) were present.

In summary, the sediments of the Inner Confluence areas of Boston Harbor have low levels of most contaminants. High lead concentrations were present at one station, moderate mercury, chromium, lead or nickel were present at others.

Reserved Channel

An estimated 478,000 cubic yards of material will be removed from the Reserved Channel, including blasting and removal of approximately 40,000 cubic yards of rock. This station was sampled at four stations (A, B, C, and D).

Stations A and B were analyzed for stratification depths of the lean clay (Boston blue clay) layer. In general the material below 20 cm was found to be lean clay. Given a total dredging depth of 1.5 meters, only 13% of this material is recent deposition. The previously stated 20% ratio of recent (i.e. contaminated as analyzed) to pristine (lean clay) is therefore very robust, but given the lack of other stratification analyses, still reasonable.

Station A in the western section of the dredging area proposed for Reserved Channel, had an 18.2 cm layer of Black Organic Clay over Gray Lean Clay (18 - 23 cm core section analyzed). The upper organic clay level consisted of 93% fine grain material with a moderate chemical oxygen demand (79,100 ppm). Lead was the only chemical constituent present in

high (Class III) concentration (221 ppm). Moderate (Class II) concentrations of oil and grease (6,300 ppm); mercury (1.48 ppm); zinc (264 ppm); chromium (186 ppm); and nickel (58 ppm) were detected. All other chemical constituents were in low (Class I) or below detectable concentrations.

Station B has a stratified analysis of the sediments for the upper 20 cm and below. The substrate was predominantly sandy organic clay in the upper 20.4 cm and lean (Boston Blue) clay at 20.5 cm to 30.5 cm (and assumed below). The upper 29 cm were analyzed for chemical constituents. This material had a low chemical oxygen demand (54,900 ppm). There were no high contaminant levels recorded. Moderate levels were present for mercury (0.55 ppm); nickel (56 ppm); and PCB (0.77 ppm). All other contaminants were in low (Class I) concentrations or below detection limits of the instrumentation.

Station C, in the eastern section of the Reserved Channel, had sediments that were predominantly organic clay with some sand, 77% fines and a low chemical oxygen demand of 60,400 ppm. High mercury levels were detected at this section and moderate levels of lead (105 ppm) were present. All other contaminants were in low (Class I) concentrations or below detection limits of the instrumentation.

Station D was located at the confluence (turning area) of the Reserved Channel and the Mainship Channel. The substrate was organic clay, 95% fines and had a moderate chemical oxygen demand (84,500 ppm). Moderate levels of volatile solids (9.28 ppm); oil and grease (3200 ppm); lead (109 ppm) and chromium (109 ppm) were also detected.

Mainship Channel

Station E and F were sampled in the Main Ship Channel region of Boston Harbor. Dredging this alternative is not currently a part of the proposed project plan. A total of 1,582,600 cubic yards of dredged material was proposed to be removed from this area (including 37,600 cubic yards of rock to be blasted and removed), but this action was not proven to be economically justified. A summary of the sediment chemistry of this region is included here to exemplify environmental conditions in the outer harbor reach where typically water circulation is less constricted.

The material at Station E is black organic clay with 88% fined grained texture and a moderate chemical oxygen demand (83,800 ppm). There were no contaminants measured in high (Class III) concentrations. Moderate (Class II) levels of volatile solids (8.23 ppm); lead (122 ppm); and chromium (131 ppm) were recorded for this station. All other contaminants were present in low (Class I) concentrations or below the instrument detection level.

Station F was predominantly organic silt with sand, 85% fine grained material with a moderate (136,000 ppm) chemical oxygen demand. No high contaminant concentrations were recorded. Moderate levels of

volatile solids (6.93 %); lead (101 ppm) and chromium (101 ppm) were detected in these samples. All other chemical contaminants were present in low concentrations or below levels of detection.

Summary

In summary the 2.1 million cubic yards of dredged material from the proposed improvement dredging will (conservatively) consist of 80% pristine blue clay and rock. The remaining material will have the general chemical characteristics as summarized in Table 3 and described below. (Table 3 and Appendix I contains regional summary of all data with corresponding volumes.) The mechanical removal of these sediments by a bucket-type dredge will mix the surficial sediments with the pristine Boston blue clay layer, resulting in an averaged chemical signature at the disposal point as summarized in Table 4 and also discussed below. At the very least, recent sediments will be layered with pristine clay at the point of disposal (see Environmental Consequences Section).

The surficial sediments represent recent deposition of fine grained material with associated contaminants. The results of the chemical sampling reflect the normal sedimentological trends that exhibit increased chemical contaminant levels with those substrates of higher total organic carbon and silt-clay content (Boehm and Farrington, 1984). Mystic River sampling Station A and B exhibited the highest levels of contamination and was also the most recently dredged. In 1982, this area was maintenanced dredged of approximately 2 meters of silt/clays that had accumulated since the 1966 maintenance dredging. This represents a deposition rate of approximately 12.5 cm/yr at this site. This high rate of sedimentation in itself is stressful for benthic inhabitants. The material accumulated at this station represents the highest contamination levels in the harbor (see Table 2) incoming from the Mystic River drainage area. In contrast, the least contaminated material in the harbor is also found in the Mystic River at Station C. This station is typical of the pristine lean clay layer of the deeper sediments without deposition of a recent silt/clay overburden.

To characterize the recently deposited dredge material that will be mixed with the clay layer, Table 3 was calculated. This summary shows low to moderate levels of 11 contaminants when averaged for all stations, except for PCB's. The 1.20 ppm concentration of PCB is elevated, with a "high" or Class III category being >1.0 ppm. Prior to disposal and concurrent with bioassay/bioaccumulation testing PCB and PAH testing will be performed throughout the project area to better define this contamination.

To characterize the final averaged chemical signature of the dredged material, Table 4 represents the volume adjusted contaminant levels combining recent and lean clay layers (including rock). As stated earlier, this represents a conservative estimate of 80% lean clay to 20% recent overburden. This calculation is based on the assumptions that

equate chemical concentrations to the instrument detection level if it is below that level, upward rounding of significant figures and where duplicate analyses of surficial layers occurred, the highest value was used. These assumptions allow a robust or worst case characterization of the material. As listed in Table 4, as a whole, the proposed improvement dredging will generate approximately 2.1 million cubic yards of Class I material, i.e. having low levels of chemical concentration, if completely homogenized. It is not anticipated that all of the clays will be mixed with silts because of the cohesive nature of the clay material. At the disposal point some biogenic reworking of the surficial silts and clays will occur, but a majority of the disposal point will encounter a "layering" of contaminated and uncontaminated material.

Table 3. Averaged Chemical Concentration of Surficial Sediments in Boston Harbor, Based on Regional Volumes and Not Including Pristine (lean) Clay Volumes

	Mean	Category
% Volatile Solids	5.2	II
Oil and Grease ppm	2252	I
Mercury ppm	0.8	II
Lead ppm	171	II
Zinc ppm	292	I
Arsenic ppm	9.7	I
Barium ppm	925	NA
Cadmium ppm	3.4	I
Chromium ppm	108	II
Copper ppm	86	I
Nickel ppm	43	I
PCB ppm	1.20	III

Based on analyses of surficial sediments averaged after volume adjustment by region.

Category I = Low Concentration
Category II = Moderate Concentration
Category III = High Concentration
NA = Not Available

Table 4. Averaged Chemical Concentration of Dredged Material from Boston Harbor (average of all depths and locations) Based on Projected Volumes in Each Region

	Mean	Category
% Volatile Solids	1.0	I
Oil and Grease ppm	450	I
Mercury ppm	0.15	I
Lead ppm	34	I
Zinc ppm	4.0	I
Arsenic ppm	1.9	I
Barium ppm	185	NA
Cadmium ppm	0.7	I
Chromium ppm	22	I
Copper ppm	17	I
Nickel ppm	9	I
Vanadium ppm	24	I
PCB ppm	0.2	I

Assumption: 1,724,400 cubic yards is blue clay and or rock that will be mixed with surficial sediments. (It is anticipated that a "layering" of contaminated and uncontaminated material will occur).

Total Volume = 2,132,000 cubic yards
Category I = Low Concentration
Category II = Moderate Concentration
Category III = High Concentration
NA = Not Available

The Massachusetts Department of Environmental Quality Engineering, Division of Water Pollution Control (MDWPC, 1986) has annually conducted chemical sampling surveys in Boston Harbor, two stations of which were in the proposed project area. These tests produced results that were predominantly within the observed ranges for most chemicals levels, averaged by region, from the Mystic River (except for Cr and Ni) and Reserved/Main Ship Channel (except for As and Ni). The MDWPC (1986) data identified PCB in the Harbor as predominantly Arachlor 1260. The state testing also identified various levels of Polynuclear Aromatic Hydrocarbons (PAH) in the vicinity of the Reserved Channel. The PAH content of the Mystic River exhibited detectable levels of Benzo (a) anthracene (11.4 ppm); benzo (k) fluoranthene (8.5 ppm); benzo (a) pyrene (6.5 ppm); chrysene (9.5 ppm); fluoranthene (19.0 ppm); phenanthrene (0.64 ppm); and pyrene (12.0 ppm). These levels for the State's sampling station warrant investigation of the proposed Federal improvement dredging areas for PAH's. Since little scientific knowledge is available as to the environmental impact of these PAH compounds, especially their synergistic effects, a two tier (bioassay/bioaccumulation type) testing procedure (Clark and Gibson, 1987 and WES, 1987) will be performed to evaluate the

presence and potential impact of PAH's in the dredged material when disposed (see section F - Environmental Consequences). These analyses are best conducted with the bioassay/bioaccumulation tests when the project receives authorization. The MDWPC (1986) analysis of sediment near the Mainship Channel at the Reserved Channel showed less than detectable levels of PAH's in the substrate.

c. Biological Environment

The phytoplankton of Boston Harbor exhibit regional, seasonal and annual changes in species and abundances related to changes in light, temperature, nutrients, water circulation and salinity. Generally the saltwater populations are dominated by the centric diatoms Skeletonema costata, Detonula confervacea, and Thallissiosira nordenskioldii, whereas freshwater inflows such as in the Mystic River are dominated by the freshwater diatom Asterionella formosa, green algae (Chlorophyceae) or blue-green algae (Cyanophyceae). Phytoplankton densities are generally considered relatively high due to the high organic loads. The Mystic River, Chelsea River and the Inner Harbor areas typically have higher population densities than the Outer Harbor. More information on the phytoplankton distribution, and species may be found in Stewart (1968) and Marine Environmental Services (1970; 1972, a, b, c; 1973; 1976, a, b; 1977, a, b).

Zooplankton populations also exhibit regional, seasonal and annual differences based on the above stated physical and chemical factors as well as the phytoplankton distribution. Calanoid copepods such as Acartia clausi, A. tonsi, Centropages hamatus, and Eurytemora hedmani are dominant and exhibit seasonal changes during the year. A variety of less abundant zooplankton, planktonic eggs and larvae are also present. A complete list of species and abundances are available in MES (1970; 1972, a, b, c; 1973; 1976, a, b; 1977 a, b).

The harbor benthic faunal assemblages have been studied in the lower Mystic River and Inner Harbor areas (Stewart 1968, MES 1970; 1972, a, b, c; 1973; 1976, a, b; 1977 a, b,). The communities are primarily made up of opportunistic deposit feeders such as polychaetes and amphipods which are associated with the harbor's organic silts. Previous studies have indicated that the lower Mystic River is dominated by the polychaete Capitella capitata (MES, 1977 a, b) and are in good agreement with the 1986 MED sampling program. The harbor is inherently stressful to benthic populations which respond to these stresses by selection of specialized species for dominance. Those organisms that are tolerant of low levels of dissolved oxygen, on a cyclic basis, survive. Where the synergistic total of all environmental stresses defaunate the substrate (eliminating non-mobile bottom dwelling organisms), the tolerant species pioneer the vacant substrate as stresses decline to tolerable levels. It is this type of benthic community, in dynamic equilibrium, that is present in Boston Harbor (dynamic in response to environmental stresses and

equilibriated to cycles of defaunation). The presence of this assemblage indicates the removal of organisms during dredging will have minimal impact on the ecological productivity of the harbor as a system.

In July and November 1986 benthic biological sampling was conducted at thirteen (13) stations in the proposed dredging area. Finfish samples and water column parameters were also obtained at various locations. Appendix II contains a description of all methodologies and results. In general, the benthic population in Boston Harbor is described below as a function of thirteen (13) stations randomly generated throughout the project area in two seasons. Statistical analyses identified four (4) replicates per station as the most data/cost efficient. The sampling program used a $0.04m^2$ Van Veen grab and screened samples through a 0.5mm sieve. Taxonomic identifications and enumerations are summarized by regions (see Appendix II).

The July Mystic River benthic population (n=12: 3 stations, 4 replicates each) was comprised of an average of 277.1 (S.D. = 269.6) organisms per square meter from an average of 2.2 (S.D. = 2.1) species at each station. The three (3) stations sampled (Station 7 was azoic in July and November) were dominated by the polychaetes Capitella capitata (61.8%); Polydora aggregata (9.0%) and Polydora ligni (8.1%). The November benthic population average 6.25 (S.D. = 11.3) organisms/m^2 from an average of 0.25 (S.D.=0.45) species/m^2. The dominants in this season were the polychate Streblospio benedicti (33.3%); Crangon septemspinosa (33.3%) and a juvenile gastropod (33.3%). This represents a statistically significant ($p<0.01$) decrease in number of species (89.7%) and individuals (98.8%) between seasons. (This calculation includes Station 7 which was azoic in both seasons).

This tremendous reduction in benthic productivity is not uncommon in urban estuaries where the cumulative effects of high organic load, vessel wakes, increasing water temperature, reduced wind mixing, and increased water column stratification combine with microbial activities that peak in late summer to reduce dissolved oxygen levels. The dissolved oxygen stress is often severe enough to eliminate non-motile benthic populations (see discussion in Affected Environment section).

The Chelsea River and Inner confluence area July benthic population was comprised of an average of 11,180.4 (S.D. = 10,941.3) organisms/m^2 from an average of 16.5 (S.D. = 6.8) species. The four (4) stations sampled were dominated by the polychaetes Polydora aggregata (28.0%); Polydora ligni (24.9%) and Capitella capitata (17.2%). The November benthic population averaged 51.6 (S.D. = 100.6) organisms/m^2 from 0.75 (S.D. = 0.93) species. The dominants were the polychaete Streblospio benedicti (41.9%); the oligochaete Tubificidae (32.2%) and Tharyx acutus (16.1%). This represents a statistically significant ($p<0.01$) reduction in both number of species (95.5%) and individuals (99.5%) between seasons.

The July benthic population in the Reserved Channel (n=8) averaged 409.4 (S.D. = 471.3) individuals/m^2 from 2.0 (S.D. = 2.7) species/m^2. These two stations (one was azoic) were dominated by the polychaetes Capitella capitata (85.5%) and Eteone flava (5.3%). The November benthic population averaged 15.6 (S.D. = 26.5) individuals/m^2 from 0.38 species/m^2. (S.D. = 0.52) (5 azoic samples). The dominants were the polychaete Polydora ligni (60.0%); the crustacean Ampelisca abdita (20.0); and the bivalve mollusc Modiolus modiolus (20%). This represents a statistically significant ($p < 0.05$) decrease in species (81.3%) and individuals (96.2%) between seasons.

The Main Ship Channel's July benthic population (n=16) was composed of 4,489.1 (S.D. = 3683.8) individuals per square meter from 17.4 (S.D. = 9.7) species. The dominant species at these four locations were the polychaetes Polydora ligni (18.5%); Polydora aggregata (17.9%); and Capitella capitata (12.0%). The November benthic population was composed of 2,113.0 (S.D. = 2772.2) organisms per square meter from 5.8 (S.D. = 6.3) species/m^2 The dominant species were Ampelisca abdita (33.2%); Polydora ligni (19.1%) and Streblospio benedicti (15.8%). This represents a decrease in densities of individuals (53%) and species (66.7%) between seasons. This decrease is not as severe as the tributary channels, most probably due to better circulation and tidal exchange in this outer harbor area, and not statistically significant in terms of inter-versus intra-station variability.

All samples (n=50) from Boston Harbor (including areas not currently proposed to be dredged) contain an average of 4,089.0 (S.D. = 5115.9) organisms per square meter from 9.5 (S.D. = 8.6) species in July. The dominant organisms are the polychaetes Capitella capitata (44.1%, S.D. = 35.5); Polydora aggregata (13.7% S.D. = 12.0); and Polydora ligni (12.9% S.D. = 11.0). Between July and November, a statistically significant ($p < 0.001$) reduction in benthic population densities and diversity (N_s) occurs. The November population contained an average of 546.6 (S.D. = 1044.4) organisms per square meter from an average of 1.8 (S.D. = 2.7) species. The dominant organisms were the polychaetes Streblospio benedicti (22.8%, S.D. = 18.7); Polydora ligni (19.8%, S.D. = 28.3); and the amphipod crustacean Ampelisca abdita (13.3%, S.D. = 16.3).

All three regions of Boston Harbor Federal channel areas that are proposed to be improvement dredged contain an average of 4,797.8 (S.D. = 8623.2) organisms per square meter from 8.0 (S.D. = 8.4) species in July. The dominant organisms are the polychaetes [3]Capitella capitata (54.8 %, S.D. = 28.3); [2]Polydora ligni (15.3%, S.D. = 7.1); and Polydora aggregata (12.3%, S.D. = 11.7). Between July and November, a statistically significant ($p < 0.005$) reduction in benthic population densities (N_i) and diversity (N_s) occurs (n=34). The November population contained an average of 28.7 (S.D. = 71.5) organisms per square meter from an average of 0.4 (S.D. = 0.7) species/m^2 The dominant organisms were the polychaetes Polydora ligni (20.0%; S.D. = 11.5); Streblospio benedicti (17.9%, S.D. = 16.8); the shore shrimp Crangon septemspinosa (11.0%, S.D.

Table 5. Dominant Species by Region, Boston Harbor 1986.

MYSTIC RIVER

July	November
(Ni = 277.1, Ns = 2.2)	(Ni = 6.25, Ns = 0.25)
Capitella capitata (61.8%)	Streblospio benedicti (33.3%)
Polydora aggregata (9.0%)	Crangon spetemspinosa (33.3%)
Polydora ligni (8.1%)	Gastropoda (33.3%)
Caulleriella sp. (8.1%)	

CHELSEA RIVER AND CONFLUENCE AREA

July	November
(Ni = 11,180.4 Ns = 16.5)	(Ni = 51.6, Ns = 0.75)
Polydora aggregata (28.0%)	Streblospio benedicti (20.3%)
Polydora ligni (24.9%)	Tubificidae (32.2%)
Capitella capitata (17.2%)	Tharyx acutus (16.1%)

RESERVED CHANNEL

July	November
(Ni = 409.4, Ns = 2.0)	(Ni = 15.6, Ns = 0.38)
Capitella capitata (85.5%)	Polydora ligni (60.0%)
Eteone flava (5.3%)	Ampelisca abdita (20.0%)
	Modiolus modiolus (20.0%)

MAIN SHIP CHANNEL (Outside of the proposed project area)

July	November
(Ni. = 4,489.1, Ns = 17.4)	(Ni = 2,113.0, Ns = 5.8)
Polydora ligni (18.5%)	Ampelisca abdita (33.2%)
Polydora aggregata (17.9%)	Polydora ligni (19.1%)
Capitella capitata (12.0%)	Streblospio benedicti (15.8%)

Ni = Mean # of Individuals/m^2
Ns = Mean # of Species/m^2

Table 6. Dominant Benthic Species in Boston Harbor, July and November 1986 (Average of the Three Project Areas) (n=34)

July

Ni = 4,797.8 (S.D. = 8623.2)
Ns = 8.0 (S.D. = 8.4)
Average (Standard Deviation)

Capitella capitata	54.8% (28.3)
Polydora ligni	15.3% (7.1)
Polydora aggregata	12.3% (11.7)

November

Ni = 28.7 (71.5)
Ns = 0.4 (S.D. = 0.7)

Polydora ligni	20.0% (34.6)
Streblospio benedicti	17.9% (16.8)
Crangon septemspinosa	11.0% (19.0)
Ampelisca abdita	6.7% (11.5)

Ni = mean # of Individuals/m^2
Ns = mean # of Species/m^2

= 19.0); and the amphipod crustacean Ampelisca abdita (6.7%, S.D. = 11.5). The inner harbor rivers and the Reserved Channel undergo remarkable reductions in densities, theoretically a population rebounding from nearly an azoic state (induced by low dissolved oxygen levels) through adult recruitment. Given the cyclic (annual) nature of low dissolved oxygen levels in Boston Harbor, the benthic inhabitants are well adjusted to colonizing and recolonizing azoic substrates annually. This type of pioneering species assemblage can be expected to quickly recolonize dredged area with minimal disruption in benthic productivity (see Environmental Consequences).

Fisheries Resources of the Inner and Outer Harbors have been inventoried by previous studies including the MES (1972, 1972 a, b, c; 1972; 1976 a, b; 1977 a, b) and Haedrich and Haedrich (1974) studies that have developed information in the Lower Mystic River. Data in the Outer Harbor was developed by Jerome et. al. (1966), Chesmore et. al. (1971) and Iwanowicz et. al. (1973).

The studies on the lower Mystic River were concentrated in the area between Amelia Earhart Dam and the Mystic River (Tobin) Bridge. Haedrich and Haedrich (1974) found that the seasonal species composition was similar to other northeast harbor communities. Winter flounder, smelt and alewives are found in the river throughout the year and are, therefore, considered residents. Ocean pout and blueback herring are summer residents, whereas sea herring is considered a winter resident.

Other seasonal transients are indicated in Appendix II. With the exception of ocean pout, these residents were identified in the 1986 NED biological sampling effort (see Appendix II).

In July and November 1986 finfish were sampled by NED using surface and bottom variable mesh (15 cm to 2 cm) gill nets (approximately 2.5 by 70 meters) with paired deployments and a six (6) meter otter trawl where possible. Rough bottom topography restricted trawling to the Mystic River and heavy ship traffic destroyed some of the gill nets. Sampling for finfish was therefore opportunistic for site and duration. The results of the July and November finfish sampling can be found in Appendix II (Tables 81 through 90).

Finfish samples using gill nets were obtained in the Mystic River during a 24 sampling hour effort on 2 different sampling days (1 in July and 1 in November). The only finfish species sampled in July and November was the rainbow smelt Osmerus mordax and green crabs Carcinus maenas were also recovered.

Finfish samples using Otter Trawls were taken in the Mystic River 9 times (5 minute tows) in July and 4 times in November. No species were collected in July except for an occasional starfish (Asterias vulgaris). In November winter flounder, Pseudopleuronectes americanus dominated the trawl catches. The pooled sample contained 443 winter flounder (58.2% male) averaging 9.59 kg (S.D. = 3.51) with an average individual weight of 0.014 kg. The windowpane flounder Scopthalmus aquosus was the next dominant species with a pooled density of 23 organisms averaging 8.87 cm (S.D. = 4.19) and individual weight calculated as 0.018 kg. Fourteen (14) rainbow smelt Osmerus mordax averaged 13.1 cm (S.D. = 3.95); twelve (12) blueback herring Alosa aestivalis averaged 11.2 cm (S.D. = 1.67); seven (7) Atlantic silverside Menidia menidia averaged 11.1 cm (S.D. = 4.20); and two longhorn sculpin Myoxocephalus octodecempinosus averaged 8.3 cm (S.D. = 0.42). Additionally, Crangon septemspinosa were estimated at 5796 individuals weighing 3.62 kg and 72 green crabs Carcinus maenas averaging 4.54 cm (S.D. = 1.12) and weighing approximately 0.026 kg each were recovered.

Gillnet finfish samples in the Chelsea River were obtained during a 48 hour sampling effort on 2 different sampling days (1 in July and 1 in November). The dominant finfish species in July (26 net hours) was rainbow smelt Osmerus mordax, four (4) of which averaged 16.0 cm (S.D. = 1.1). Also present were: an alewife Alosa pseudoharengus (26.5 cm); a menhaden Brevoortia tyrannus (23.0 cm); a spider crab Libinia emarginata (6.7 cm) and four (4) green crabs Carcinus meanas (6.3 cm). The 12 sample hour gillnet deployment in November did not capture any organisms.

Finfish samples in the Mainship Channel area were obtained during a 72 sampling hour effort on 4 different sampling days (2 in July and 2 in November). The dominant finfish species was winter flounder, Pseudopleuronects americanus in all samples. Sampling at Outer Mainship

Channel sites (stations 5 and 6) obtained more species and individuals than Inner Mainship Channel sites (stations 3 and 4) in both seasons.

In addition to winter flounder, the July sampling obtained rainbow smelt Osmerus mordax; lobster Homarus americanus; alewife Alosa pseudoharengus; windowpane flounder Scopthalmus aquosus; Atlantic menhaden Brevoortia tyrannus; and Jonah crab Cancer borealis. The November sampling revealed the same winter flounder dominance and: rainbow smelt Osmerus mordax; windowpane flounder Scopthalmus aquosus; tomcod Microgadus tomcod; Atlantic mackerel Scomber scombrus; blueback herring Alosa aestivalis; longhorn sculpin Myoxocephalus octodecemspinosus; Jonah crab Cancer borealis and green crabs Carcinus meanas.

The 1986 NED sampling effort therefore indicates fisheries movement through the project are of the following commercial species: winter flounder Pseudopleuronectes americanus; rainbow smelt Osmerus mordax; alewife Alosa pseudoharengus; blueback herring Alosa aestiualis; Atlantic menhaden Brevoortia tyrannus and lobster Homarus americanus (See 4. Ecologically Significant Species).

Haedrich and Haedrich (1974) found the major food sources are generally as described for the species (N.O.A.A., 1984) elsewhere. Winter flounder feeds mainly on the polychaete Capitella capitata and soft shell clams Mya arenaria; smelt primarily on sand shrimp Crangon septemspinosa and other small crustaceans; and alewives and herring on zooplankton.

Information on spawning species, numbers and quality of spawn and their significance to regional resources is imprecise and sketchy. Since the principal streams discharging into the Inner Harbor rivers have dams located on them, tidal spawns of smelt and alewives are unlikely. In addition, it is not known if winter flounder use Boston's Inner Harbor for spawning as well as an area of local feeding. From the habits of these fish and from their behavior in the Mystic River channel area, they appear to stay in particular resident areas within the Inner and Outer harbors. Larval contribution to the eventual recruitment of these fish in other areas is not known.

Offshore and longshore areas of the harbor were trawled for finfish in the studies done by the Massachusetts Division of Marine Fisheries. Atlantic silverside, mummichog and Atlantic tomcod were the predominant species found in the longshore trawls. Some of the offshore sampling sites yielded high densities of winter flounder, Atlantic tomcod, fourspine stickleback, and rainbow smelt. The highest densities of finfish were taken during the months of September and October, with Atlantic silverside and winter flounder the predominant species. The densities of finfish dropped during the winter months of December through March as the fish moved offshore to winter feeding grounds.

The softshelled clam (Mya arenaria) is the most common commercial shellfish within the Boston Harbor area. Blue mussels Mytilus edulis and duck clams Macoma balthica are also found in shellfish beds but are not harvested. Densities of shellfish beds have been documented by the Jerome et al. (1966), Chesmore et al, (1971) and Iwanowicz et al. (1973) and this data should be referred to for detailed information.

Waters overlying the shellfish beds are contaminated by wastes from sewage outfalls, resulting in the presence of coliform bacteria in the shellfish. The beds are under the jurisdiction of Massachusetts DEQE (Department of Environmental Quality and Engineering) and are closed to commercial and noncommercial harvesting, except by Master Diggers who must have the clams depurated at a purification plant.

Most of the productive softshelled clam beds near the proposed dredging project are closed except for restricted areas near Logan Airport and a seasonal area in Pleasure Bay, the latter located immediately southwest of Castle Island. Logan Airport beds are one nautical mile north of President Roads and the beds at Pleasure Island are about two nautical miles west of President Roads. Shellfish beds open to Master Diggers are predominantly within the lower bays and are substantially distant from the shipping channels and project areas.

The limited amount of lobstering within the Boston area takes place primarily in Quincy, Dorchester and Hingham Bays. Lobstering is minimal or nonexistent in the areas to be primarily affected by the proposed work.

2. Disposal Site

a. General

The material dredged from the proposed project site will be placed on a barge and transported approximately 25 nautical miles east to the Foul Area Disposal Site. This disposal will require approximately 1500 barge trips, depending on the barge capacity, from the project area to the disposal point.

The site, located in Massachusetts Bay (see Figure 4) in 100 meters of water, is an Environmental Protection Agency (EPA) approved interim ocean dredged material disposal site with a circular boundary of two nautical miles diameter as identified in the Federal register as Marblehead (40 CFR 228.12). The center of the site is 42^{o}-25.7' north latitude and 70^{o}-34.0' west longitude, approximately 14.5 nautical miles southeast of Manchester Bay, Manchester, Massachusetts, 26 nautical miles northwest of Race Point, Provincetown, Massachusetts and 10 miles south southeast of Eastern Point, Gloucester, Massachusetts. This disposal site is locally called the Foul Area because of the many fishing net "hangs" that could foul the equipment.

The general vicinity of the Foul Area Disposal Site (FADS) has received wrecks, dredged material, organic and inorganic compounds and construction debris since the 1940's. Earlier disposal was not at a specified point, but sufficiently far from land to reduce the impacts of disposal. Most dredged material was disposed at sites closer inshore, especially the "Boston Lightship" Disposal Site. Historically, some dredged material considered "contaminated" (without any testing) or oil laden was disposed at the offshore area eventually termed the "Foul Area." Often Boston Harbor dredged material, including material from the last Federal Channel maintenance dredging, has been disposed at the Foul Area Disposal Site.

The Coast Guard "A" buoy, for identifying the disposal site, was deployed at 42°-25.7' N and 70°-35.0' W from 1947 through 1975. In 1975, at the request of the Commonwealth of Massachusetts, the buoy was removed to its present location (42° 25.7' N and 70° 34.0' W). In 1977, the Ocean Dumping Regulations (40 CFR 220-229) established an overlapping 2 nautical mile diameter circle centered 1 nautical mile east (42°-25.7' N and 70°-34.0' W) of the previous site to receive dredge material. This site has received approximately 3 million cubic yards of dredged material between 1975 and 1985, a majority of which came from Boston Harbor dredging projects. FADS has received dredged material of varying composition from those harbors listed in Appendix I. The clay, rock, silty sand and sandy silt to be dredged from the proposed improvement project is typical of the materials deposited at FADS.

The material to be disposed from this project area during construction and subsequently as maintenance dredging occurs must have a low energy environment for stability in containing the disposal material (especially silt) within the designated site. The estimated 100,000 cubic yards of rock can be used to create relief habitat and remain stable at any site (see G - Mitigation). During the past disposal activity at FADS 62.1% of all material was silt and clay (greater than 4 phi) and 37.3% was sand (-1 to 4 phi) the remaining 0.6% was gravel (less than -1 phi). Much of the material disposed was a mixture of sandy silt. The Foul Area Disposal Site has retained this material because of the stable nature of this deepwater offshore site. Nearshore disposal could allow storm activity to resuspend dredged silt and clays. Upland disposal sites are few and expensive on this urban coastline. The majority of material at FADS, in cubic yardage, has come from Boston Harbor (67%) with harbors south of Boston comprising 20% of the material historically disposed at FADS. The remaining 13% was generated from dredging projects in harbors north of Boston to Gloucester, Massachusetts. The composition of chemical and biological parameters at FADS has been the subject of intensive scientific analysis by the New England Division (NED) who has the responsibility to manage and monitor the disposal of dredged material at this site. NED is currently conducting oceanographic studies of FADS that will be used to support designation of the interim site as a permanent EPA approved dredged material disposal site. Included in these studies are biological inventories designed to expand on the available biological data (New England Aquarium, 1975 and S.A.I.C., 1985) for this site.

b. Physical and Chemical Characteristics

Preliminary results of FADS oceanographic studies indicate the site to be located in a low energy, deep water environment, allowing containment of dredged material within the site. The disposal buoy is at a 100-meter deep portion of the site, where maximum bottom currents are less than 35 cm/sec (SAIC, 1984). Analysis of a hopper dredge disposal, which disposed a mixture of water and dredged material in a slurry, defined a disposal plume settling within a circle of a 350-meter radius.

The physical properties of the substrate near the disposal point is varying in composition, predominantly sandy silt, reflecting the various harbor dredging projects disposed here. The natural bottom covering the majority of FADS, i.e. areas of the silt that have not received dredged material, is a fine silt/clay substrate (NED unpublished data). The composition of this natural material indicates the basin is a depositional area capable of containing the dredged material. If sufficient currents frequented this area of the basin, the fine grained material would be suspended and transported with the currents. Areas of high current velocities would therefore have a coarse grained (heavier than silt/clay) substrate, a substrate that is not typical of this basin, but is present in the shallow (approximately 60 meter deep) northeast quadrant of FADS. This area is a rock/cobble/sand area, at the 60 meter isopleth relief west of Stellwagen Bank.

A summary of the chemical composition of 25 stations from FADS is presented in the DAMOS (Disposal Area Monitoring System), 1984 Program Results Document (SAIC, 1985). The actual tables of results are included in Appendix II of this report. In general the April 1983 chemical concentrations of the substrate at FADS can be categorized as Type IA and IIA. Percent volatile solids averaged 3.3% (S.D. = 0.1) which is Type A. Oil and grease concentrations measures 152.0 ppm (S.D. = 75.1) and this concentration is considered Category II. Copper concentrations in FADS sediments were in Category I of 64.8 ppm (S.D. = 32.7). Arsenic concentrations were averaged as Category I, 9.8 ppm (S.D. = 3.4); and the standard deviation exhibited a range into the Class II category. Earlier cruises in January 1983 analyzed mercury and lead at FADS at nine stations (SAIC, 1985) and found Category I lead and mercury levels of 44.2 ppm (S.D. = 18.0) and 0.11 ppm (S.D. = 0.40) respectively. All other levels were comparable or less than the April 1983 values except percent volatile solids (4.3, S.D. = 1.9). No PCB concentrations were reported; however indications from present studies define spatial variability in concentrations ranging from Category I through III.

c. Biological Characteristics

Recent sampling of the benthos at the Foul Area Disposal Site (S.A.I.C., 1986) described three distinct community assemblages as occurring. These assemblages reflect the various sediment facies within the site.

The northeast section of the site has an unimpacted coarse sand and gravel composition. The benthic community was sampled in the fall of 1985. This assemblage was numerically dominated by the Syllidae polychaete Exogone verugera profunda ($907/m^2$); the Paraonidae polchaete Levinsenia gracilis ($350/m^2$); and the Spioidae polychaete Prionospio steenstrupi ($313/m^2$). A total of 105 species averaging 4,433 organisms per square meter were recovered.

The western portion of the Foul Area Disposal Site has been impacted by continued disposal of dredged material from the greater Boston region. Approximately 3 million cubic yards per decade of material is disposed in this section of FADS. This continual disturbance of the bottom maintains the community of benthic organisms in a dynamic equilibrium. The most adaptable species proliferate. Those species that reproduce rapidly and have high numbers of offspring (i.e., larvae) colonize the newly disposed dredged material (r-strategists of classical ecology) and biogenically rework the substrate. Given time, this pioneering community would alter the sediment character and allow a more mature community to develop. The frequent disposal activity maintains the resident population of the disposed material area as a pioneering sere. This assemblage at FADS was dominated (fall 1986) by oligochaetes ($6,293/m^2$); the Spionidae polychaete Spio pettibonae ($4,607/m^2$); the Cirratulidae polychaete Chaetozone setosa ($2,160/m^2$); and the Capitellidae polychaete Mediomastus ambiseta ($1,757/m^2$). A total of 78 species averaging 25,467 organisms per square meter were recovered.

The southeastern section of FADS has an unimpacted silt/clay sediment facies. The lack of physical disturbance (burial) by disposal of dredged material has allowed a mature benthic assemblage to become established. Interspecific competition within a mature community results in a presence of considerably lower densities of individuals (e.g. $8,390/m^2$) than found in continually disturbed habitats (e.g. $25,467/m^2$). The undisturbed southeastern section of FADS was dominated by the Paraonidae polychaete Levinsenia gracilis ($1,583/m^2$); oligochaetes ($1,050/m^2$); and the Capitellidae polchaete Mediomastus ambiseta ($693/m^2$). The fall 1985 sampling in this section of FADS recovered a total of 57 species averaging 8,390 individuals per square meter.

Various finfish species have been collected during recent sampling cruises (S.A.I.C., 1986) within the Foul Area Disposal Site. In the spring of 1985, the spiny dogfish Squalus acanthias was the dominant finfish recovered. This species migrates seasonally in large schools. Those sampled at FADS were found to be feeding on flounder, sculpin, and anemones. Fall 1985 finfish collections were dominated by the witch flounder or grey sole Glyptocephalus cynoglossus and the dab or american plaice Hippoglossoides platessoides. The former was found to be foraging on polychaetes (e.g. Chaetozone sp.; Spio sp.; Sternapsis sp. and Tharyx sp.). The latter was found to be foraging on brittle stars (Ophiuroidea).

The Foul Area Disposal Site is approximately 5.5 kilometers west of a submerged (30 meters deep) topographic rise called Stellwagen Bank. This bank is a known feeding area of various marine mammals including the Humpback whale Megaptera novaeagliae and the Fin whale Balaenoptera physalus. These and other marine mammals have been observed in the vicinity of FADS.

3. Threatened and Endangered Species

The intertidal and subtidal areas including and adjacent to the Federal channel area are not known habitat for any threatened or endangered species. The Foul Area Disposal Site (FADS) is located in Massachusetts Bay, an area known to be utilized by various marine mammals. Endangered whale species are known to congregate above the shallow (30 meter) Stellwagen Bank (U.R.I, 1981) when foraging for prey (e.g. sand lance Ammondytes americanus). These species also have been observed within the 2 nautical mile circular boundary of FADS. Endangered species identified as transients of FADS include the Finback Whale Balaenoptera physalus; the Sei Whale Balaenoptera borealis; the Humpback Whale Megaptera novaeangliae and possibly the Northern Right Whale Eubalaena glacialis (MBO, 1987). The impact of the use of FADS on endangered species is currently being assessed by the New England Division of the Corps of Engineers. The interim status of this site as an area for dredged material disposal assumes no impact on endangered species. Full coordination of this assessment with National Marine Fisheries Service and the U.S. Fish and Wildlife Service ensures compliance with the protection of endangered species and their habitats. Upon completion of bioassay/bioaccumulation testing, an endangered species consultation will be initiated.

4. Ecologically Significant Species

The 1986 benthic sampling program identified the polychaetes Capitella capitata and Streblospio benedicti as the ecological dominants of the project area. Finfish sampling identified anadromous finfish, resident finfish and lobster as occurring in the project area. In a recent report by the National Oceanic and Atmospheric Administration (N.O.A.A., 1984), anadromous finfish species were identified as being of special concern in the project area. Each of these organisms occur in seasonal cycles throughout the project area as summarized in Table 8.

Winter flounder Pseudopleuronectes americanus are cold water spawners in mid-December through mid-May. Adults are known to migrate to cooler waters in the spring and to return in late fall. Estuaries serve as nursery grounds for juveniles until 2 years old. In Boston Harbor, the warm inner harbor water temperatures restrict this species to the deeper, cooler outer harbor (e.g. Mainship Channel area) for much of the year. Spawning may be occurring on sandy substrate in the Chelsea River and Mainship Channel regions in winter, but the propwash from large tugboats

and petroleum carriers, especially frequent in the Chelsea River during winter months, does not likely allow significant spawning successes in these areas.

Numerous efforts to restore anadromous fishery runs in Boston Harbor are underway, including fish ladders and passages. Although the proposed project regions do not include any (freshwater) spawning areas, anadromous spawning movements can be expected to occur in the spring through the Mystic River region of the project.

Smelt Osmerus mordax are anadromous estuarine organisms spawning in freshwater March through mid-May. The adults return immediately to the estuary where they reside year-round.

Alewife Alosa pseudoharengus is an anadromous species that also spawns in freshwater, in April through late May. These nocturnal organisms emigrate throughout the summer in the Gulf of Maine. They are year-round residents of Boston Harbor and can be expected to display anadromous movements as described for smelts.

Blueback herring Alosa aestivalis is an anadromous species known to spawn upriver during late afternoon and night in late April through mid-September. This species is generally present in the project area in spring through late fall. Its anadromous movements would most likely be as described above.

Atlantic menhaden Brevoortia tyrannus is an inhabitant of coastal and estuarine waters from Nova Scotia to Florida. Adults occupy near surface waters, in shallow areas. Spawning occurs chiefly in offshore waters during the summer, with pelagic larvae maturing after one month and entering the estuary as juveniles. This species would most likely be found in large schools in the outer harbor but small schools move throughout the project area during spring through fall.

The lobster Homarus americanus brood their eggs, with spawning occurring April through June with larvae hatching beginning mid-May. Although technically illegal, the Mainship Channel region of Boston Harbor is actively "potted" for lobsters. The species can be expected to migrate with response to seasonal temperature and dissolved oxygen concentration shifts. Although lobsters were not recovered in 1986 samples taken within the project area, they can be expected to occasionally migrate within the project vicinity.

The polychaetes Capitella capitata and Streblospio benedicti are the dominant benthic organisms present in the project area. Both of these species are tolerant of physical and chemical stresses that are characteristic of urban harbors such as Boston. Each of these species are "r - strategists," i.e. species whose life history is characterized by small body size, short generation times and high reproduction (r) rate (Grassle and Grassle, 1984). Capitella capitata has shown generation

times as short as three (3) weeks (Tenore and Chesney, 1985). These life history attributes allow the proliferation of this species within the project area on a cyclic basis. High densities of Capitella capitata were found in July but not in November. The high suspended organic load present in Boston Harbor facilitates water column oxygen depletion as the inner harbor warms and stratifies (i.e. an "August Effect") in late summer. This depletion is severe enough, in combination with other environmental stresses, to defaunate substrates. Winter mixing and cooling allows the r-strategists to re-establish their densities. This cyclic proliferation and die-off keeps the benthic population in a state of dynamic equilibrium. Those project areas azoic in both sampling periods may have a sufficient additional stress of sulphidic or petroleum compounds accumulating in the substrate that is intolerable to even these species (James and Gibson, 1980). This cycle of recolonization by the benthos can be expected to allow rapid biogenic reworking and recolonization of the newly exposed clay layers in the post dredging phase.

In summary, a spring/summer movement of anadromous finfish occurs through the project area as they move into spawning (freshwater) tributaries. Lobsters and flounder are generally in the outer harbor (areas of high productivity) preferring cool waters. In summer, as water temperatures rise, productivity in benthic habitats sharply decline in response to low dissolved oxygen in the near bottom water column, restricting fauna to the outer harbor (Mainship Channel) areas. By fall the inner harbor has juvenile flounder feeding on shore shrimp while waters are cooling toward winter spawning temperatures. In winter, finfish, except for the cold water spawning flounder, and lobster move offshore as harbor water temperatures decrease. This fall/winter water cooling allows a balance of the oxygen depletion that occurred in the warmer seasons. High organic load freshwater inputs and warming water temperatures initiate the complex cycle in the spring.

Table 7. Seasonal Occurrence and Spawning Period of Ecologically Significant Species in the Proposed Project Area

Project Region Species of Concern	Spawning Season	Season of Occurrence in Project Area	
Winter Flounder *Pseudopleuronectes americanus*	year-round	January through May (on sandy substrate)	Spawning substrates in the Chelsea River
Rainbow Smelt *Osmerus mordax*	year-round	March through mid-May (anadromous)	Pelagic spawning transients in the Mystic River

Alewife Alosa pseudoharengus	year-round	April through late May (anadromous)	Pelegic spawning transients in the Mystic River
Blueback Herring Alosa aestivalis	spring through fall	May through September (anadromous)	Pelegic spawning transients in the Mystic River
Menhaden Brevoortia tyrannus	spring through fall	spring and fall offshore	present but not a significant habitat
Lobster Homarus americanus	spring through fall	spring	foragers spring through fall
Polychaete Capitella capitata	predominant in spring/summer	(r-strategists)	none
Polychaete Streblospio benedicti	predominant in fall/winter	(r-strategists)	none

5. Historic and Archaeological Resources

Boston Harbor has been subject to navigation improvement projects since the mid-nineteenth century. The channels and river in and around the harbor have been deepened, widened, and straightened. This activity has severely limited the historic and archaeological potential of the harbor. The Chelsea Street Bridge is a Strauss heel-trunnion bascule bridge, the only surviving example of its type in Massachusetts.

6. Social and Economic Resources

Natural Resources

The Metropolitan Area Planning Council (MAPC) and the city of Boston are both very active in preparing plans for recreational development and conservation of land along the waterfront. The major emphasis of the waterfront plans of these agencies is towards those uses which provide for a public enjoyment of the harbor and the preservation of its ecological resources.

In 1976 MAPC published the Boston Harbor Islands Comprehensive Plan. (Boston Harbor Island Comprehensive Plan, prepared for Massachusetts Department of Natural Resources by the Metropolitan Area Planning Council, October 1972.) Under this plan it is proposed to protect all the harbor islands from undesirable uses and to either develop their potential as historical sites and recreation areas or to leave them undeveloped as conservation areas. The plan also envisages turning much of the outer harbor waterfront into conservation areas.

The plan envisages the development of harbor islands to provide the following annual recreational opportunities:

		Recreation Person - days		
Group Camping	34,000	"	"	"
Family Camping	6,000	"	"	"
Primitive Camping	1,200	"	"	"
Fishing	54,000	"	"	"
Play	220,000	"	"	"
Historic Fort Visitations	305,000	"	"	"
Swimming	335,000	"	"	"
Picnicking	203,600	"	"	"
Boating	111,000	"	"	"
Hiking, Nature Walks, etc.	222,850	"	"	"
Conference and Recreation Center	130,000	"	"	"
Model Farm Visitation	70,000	"	"	"
Fish Hatchery Visitation	10,000	"	"	"

MACP published the 1976 Regional Open Space Plan in July 1976. In addition to the Harbor Islands Plan, it proposed that the following recreational and conservation areas be developed or improved along the harbor front.

- Chelsea Naval Hospital. A 20-acre waterfront park is recommended for the southwestern part of the site.

- Downtown Waterfront. Linking the waterfront park between Commercial and Long Wharves to Government Center by a traffic free pedestrian mall. This can be realized if the central artery is depressed as proposed.

- Belle Isle Marsh - Protection

- Constitution Beach, East Boston - Improvement of water quality to protect the beach.

- Dorchester Bay - Public control of the coastline and the design of a Dorchester Bay Reservation from South Boston to Tenean Beach.

- Mainside Park, Hingham - Development of the park as proposed by the town of Hingham.

- Nantasket Beach, Hull - That the open space/recreation value of the beach be protected from incompatible nearby development and that maintenance be improved.

In September 1976, the Boston Redevelopment Authority produced the Boston Urban Wilds Program. This identifies 573 acres of shoreline

property along the harbor to be either developed as parkland or protected as a conservation area. In addition, the city of Boston's Conservation Commission is acquiring an 11-acre site to develop a waterfront park at the corner of Summer and New Streets in East Boston. The city is also planning a small park where the Charlestown Bridge abuts Charlestown, an extension of the existing North End Park towards Charlestown Bridge and a small park on Fort Point Channel in front of the relocated Children's and Transportation Museum. A large waterfront park is currently under construction on the Little Mystic Channel in Charlestown.

Human Resources

Dense urban concentrations of population surround the inner harbor with the cities of Boston, Cambridge, Somerville, Everett, and Chelsea within metropoliton Boston. Population densities vary inversely with distance from the metropoliton core, with the exception of the town of Winthrop and Hull at the extremities of the bay. These towns, with very limited areas and considerable waterfront, have experienced a high degree of development. Table 8 describes the population characteristics of the immediate Boston Harbor communities.

The period from 1960 to 1980 was an era characterized by an outmigration of population from the metropolitan Boston area. The population of Boston declined approximately 8 percent between 1960 and 1970 and approximately 12 percent between 1970 and 1980. Similar declines were experience for the entire metropolitan area. This information is also contained in Table 8.

TABLE 8
POPULATION BOSTON
METROPOLITAN AREA

Place	1980	1970	1960
Boston	562,994	641,071	697,197
Cambridge	95,322	100,361	107,716
Somerville	77,372	88,779	94,697
Everett	37,195	42,485	43,544
Chelsea	25,431	30,625	33,749
Total	798,314	903,321	976,903

Per capita income (1982 dollars) increased in the metropolitan area with the exception of Everett which declined approximately 0.2 percent between 1974 and 1979. Per capita income increases were the largest in Boston. Table 9 portrays per capita income in the Boston area.

TABLE 9
PER CAPITA INCOME,
BOSTON METROPOLITAN AREA
(1982 DOLLARS)

City	1974	1970	% Change
Boston	$7,698	8,340	8.3
Cambridge	9,774	10,123	3.6
Everett	8,313	8,295	-0.2
Lynn	8,192	8,253	0.7
Quincy	9,365	9,701	3.6
Revere	8,319	8,473	1.9
Somerville	7,922	8,078	2.0

During the early stages of the Industrial Revolution, water was both a prime source of power for industry and the main means of transport. With the advent of the steam engine and railroads, dependence on water was lessened, but transport by sea still remained cheaper than by land. An ocean port such as Boston is the interface between land and sea, and also the point of arrival of merchandise from foreign lands. The port's waterfront was not only the point for transfer from ocean to inland transport, but the point at which goods had to be inspected and customs duties assessed. It was the logical point to store and distribute imports as well as to locate industries dependent on seaborne materials. There were also a large number of sea related activities, such as ship building, ship repairs, and provisioning. Prior to the development of air transport, ports handled all transoceanic passenger traffic. This resulted in a high demand for waterfront land and its intense development for port, commercial, and industrial activities.

The picture has now changed largely due to modern means of transporting and handling goods. The introduction of containers as an important means of transporting general merchandise coupled with the inland transport under customs bond (i.e. sealed) has made it convenient to locate the point of customs clearance and distribution inland. Ship building has declined dramatically in the United States and is concentrated in a few highly mechanized shipyards, such as the General Dynamics Yards in Quincy. Ship repairing has gravitated to countries with low labor costs and many repairs are carried out at sea while the ship is in operation.

The most dramatic shift in waterfront usage has come about from modern methods of transport, such container transport, roll on/roll off ships and LASH barges. These methods of handling waterborne port trade have drastically shifted the resource requirements from operations heavily dependent upon labor to one of heavy capital investments. These cargo handling procedures have drastically shortened the time to load and unload ships. Due to the heavy capital investments in ships and dock equipment, it is imperative that ships be turned around in minimum time to be profitable. A large container ship can be turned around in eight hours,

whereas, an equivalent break-bulk (non-containerized general cargo) ship would require 36 hours, or 4 to 5 eight hour working days. For example, any vessel not vacating its berth on completion of its operations is presently subject to a heavy charge at the Moran Container Terminal in Boston Harbor. The size of ships has also increased. The number of vessels arriving in the harbor has steadily decreased, while tonnage handled has increased. This has led to a decrease in the number of berths and piers needed to handle port traffic. Further, modern handling methods require entirely different layouts, entailing major reconstruction. Old wharves are abandoned and often replaced by new ones at other locations.

Containerization has become a vital sector of international waterborne commerce. Competition between ports has forced the terminal industry to adopt this modern handling method. In addition to its cost efficiency, containerization has greatly reduced the degree of pilferage and damage to cargo. With the rapidly increasing containerized trade, the port must service the incoming containerships efficiently to maintain its port trade.

The overall result has been the abandonment of waterfront sites, or their conversion to other industrial or commercial uses not requiring waterfront access. Piers have been allowed to deteriorate, abandoned vessels been allowed to sink without removal, and debris has accumulated. Furthermore, with the abandonment of many terminal sites and streamlining of material handling methods, waterfront employment has decreased dramatically. Residential areas built to house waterfront workers have degenerated.

In Boston the effects have been greatly compounded by the closing of three major military installations which supported a sizeable labor force and many ancillary industries.

The result is to present cities surrounding the inner harbor with an aspect of large scale desolation around the greatest attraction and reason for existence. It also presents them with an opportunity for redevelopment as attractive waterfront sites have a great potential for residential and commercial use. Increased values of residential property with an attractive waterfront is well demonstrated. Houses near Brophy Park in the Jeffries Point District of East Boston with a view over the harbor to Central Boston fetch about $8,000 more than houses without a view, according to an East Boston realtor. A study was done of the 1975 sale records of condominiums on Beacon Street and Marlborough Street between Arlington Street and Massachusetts Avenue. (Records of sales in 1975 were obtained from the Boston Redevelopment Authority. Only condominiums in older buildings were considered, 1890 and 324/344 Beach Street, modern relatively high rise apartment blocks being excluded. Thus, while individual apartments were not inspected, the apartments in similar houses were compared.) The average price of 19 condominiums on the north side of Beacon Street, which has a view across the Charles River to M.I.T., was $44,500. The average price of 26 comparable condominiums on the south

side of Beacon Street and on Marlborough Street which dc not have a view was $38,290. Apartment rents in the Mercantile Building facing the harbor across a park are about $25 per month higher than those facing inland.

The city of Boston has recognized the opportunities of fruitful redevelopment in waterfront areas and commenced to realize them. The North End Waterfront between Lewis Wharf and the entrance to Fort Point Channel have been redeveloped. Warehouses on Lewis, Commercial, and Long Wharves have been converted into attractive offices, shops, restaurants and condominiums by private developers with city assistance. The New England Aquarium and a high rise block of apartments were built on the waterfront. The city of Boston has invested over $6,000,000 in improving streets, sidewalks, sewers, and lighting, as well as a waterfront park. The success of the project can be attested by the fact that $60,000 is being asked for one bedroom condominiums on Lewis Wharf in 1977, which where sold for $42,000 when the building opened in 1973.

The Metropolitan Boston area has been experiencing a dramatic shift in the labor market demands as a result of the employment developments within the major manufacturing and service sectors. Over the past 25 years there has been a decrease in employment of 62 percent in the manufacturing sector while employment in the services sector has grown by 80 percent. Overall employment which was 522,000 in 1950 declined by 3.5 percent to 504,000 in 1960, but increased by 5.2 percent to 530,300 in 1970. The net increase of 26,300 jobs during the last period was the result of an increase of roughly 60,000 jobs in the service sector and the loss of approximately 30,000 jobs in the manufacturing and trades sectors.

The average annual nonagricultural wage and salary employment in the Boston-Lawrence-Salem-Lowell-Brockton, MA New England County Metropolitan Area (NECMA) during 1983 was 2,064,900 jobs. This increase of 338,800 jobs over the 1969 annual average represents an annual growth rate of approximately 1.3 percent. During this period, employment in the nonmanufacturing sector grew by 331,700 jobs accounting for 98 percent of the total employment gains. The manufacturing sector recorded an increase of 7,100 jobs over this period.

The major industries in terms of employment in the Metropolitan Boston area consist of the machinery, instruments, transportation equipment, fabricated metals, and printing industries within the manufacturing sector. The wholesale and retail trades, services, and government employ the largest numbers of workers within the nonmanufacturing sector. Table 10 illustrates the historical and projected population, employment, personal income, and earnings within the Boston area.

TABLE 10

BOSTON-LAWRENCE-SALEM-LOWELL-BROCKTON, MA (NECMA)

Table A-Population, Personal Income, and Earnings, 1969-1983, and Projected, 1990-2035

	1969	1983	1995	2035
Population as of Jul 1 (thousands)	3,682.8	3,673,4	4,141.3	4,990.0
		Millions of 1972 dollars		
Total personal income (place of residence)	17,800.3	24,586.3	34,869.8	60,336.7
BY PLACE OF WORK				
Total Earnings	14,442.2	19,124.0	28,769.3	47,659.7
Farm	30.9	29.7	26.5	30.9
Nonfarm	14,411.3	19,094.3	28,742.8	47,628.7
Private	12,417.8	16,619.4	25,747.9	43,272.5
Construction	914.2	783.3	1,208.1	1,881.3
Manufacturing	3,825.5	4,901.1	8,158.3	15,309.9
Nondurable goods	1,478.7	1,198.9	1,478.1	2,014.1
Durable goods	2,346.8	3,702.2	6,680.2	13,295.8
Transportation and public utilities	898.5	1,258.1	1,992.8	3,462.8
Wholesale trade	1,044.2	1,313.4	1,846.5	2,930.6
Retail trade	1,577.8	1,693.1	2,244.7	3,414.8
Finance, insurance and real estate	1,035.6		2,337.6	3,655.3
Services	3,075.4	5,108.2	7,860.0	12,531.7
Government and government enterprises	1,993.6	2,474.9	2,994.9	4,258.3

Table B-Employment by Place of Work, by Industry, 1969-1983, and Projected, 1990-2035
(Thousands of Jobs)

	1969	1983	1995	2035
Total employment	1,726.1	2,064.9	2,638.7	2,908.3
Farm	6.3	5.5	5.0	4.3
Nonfarm	1,719.8	2,059.6	2,633.7	2,904.0
Private	1,470.3	1,781.2	2,346.2	2,632.6
Construction	84.2	74.6	102.1	112.6
Manufacturing	403.5	410.6	546.6	635.0
Nondurable goods	178.2	121.8	123.8	105.2
Durable goods	225.3	288.8	422.9	529.8
Transportation and public utilities	87.2	92.0	116.5	132.9
Wholesale trade	98.9	115.2	139.2	158.1
Retail trade	283.2	330.6	412.7	450.4
Finance, insurance and real estate	104.4		191.0	218.3
Services	401.6	605.3	820.7	902.3
Government and government enterprises	249.5	278.3	287.5	271.4

In July 1986, 50,520 of the total resident labor force of 1,550,060 were unemployed. This unemployment rate of 3.3 percent compared with the rate of 3.8 percent for Massachusetts, was 0.5 percentage points less than the July 1985 average of 4.3 (DES Employment Review, July 1986).

Development and Economy

The port and industrial facilities within the harbor are located primarily along the shorefronts of the city of Boston and the neighboring communities of Everett, Chelsea and Charlestown. There are a total of approximately 156 piers, wharfs, and docks located within the port of Boston, 80 percent of these facilities located within the limits of the inner harbor. The remaining 20 percent of these facilities are located along the waterfront within the communities of Winthrop, East Boston, Dorchester, Quincy, Braintree and Weymouth. Table 11 summarizes the number and location of these facilities.

However, the modernization of cargo handling methods and the increasing size of vessels entering the harbor has resulted in the abandonment of waterfront sites engaged in cargo handling operations. Piers have been allowed to deteriorate or converted to other industrial or commercial uses not requiring waterfront access.

The North End Waterfront in the center of Boston has been renovated and many of the old stone warehouses have been converted into attractive apartments, offices, restaurants and shops. Harbor Towers, a highrise

apartment block, and the New England Aquarium have been built on the waterfront. A park has been placed between Long and Commercial Wharves giving central Boston access to the waterfront.

TABLE 11

PORT AND HARBOR FACILITIES

Locality	Number of Waterfront Facilities
Winthrop:	
Winthrop Head	1
East Boston:	
Belle Isle Inlet	1
Dorchester:	
Neponset River	5
Quincy:	
Neponset River	2
Town River	8
Weymouth Fore River	5
Braintree:	
Weymouth Fore River	3
Eastern Neck and Hingham:	
Weymouth Back River	2
Weymouth:	
Weymouth Fore River	2
East Boston:	
Main Ship Channel	23
Chelsea River	7
Revere:	
Chelsea River	3
Chelsea:	
Chelsea River	15
Had of Main Ship Channel	1
Everett:	
Island End River	1
Mystic River	7
Malden:	
Malden River	1
Medford:	
Malden River	2
Somerville:	
Mystic River	3
Charlestown:	
Mystic River	7
Main Ship Channel	2
Charles River	1
Cambridge:	
Keognere Canal	1

Broad Canal	2
Boston:	
Charles River	2
Main Ship Channel	18
South Boston:	
Fort Point Channel	4
Main Ship Channel	10
Reserved Channel	15
Main Ship Channel 2	
TOTAL FOR OUTER AND INNER HARBORS	156

Boston Harbor is surrounded by the largest metropolitan area in New England with a population approaching four million. While not one of the most rapidly expanding areas in the United States, the Boston area is nevertheless maintaining a dynamic and expanding economy. The OBERS Series E Projections for the area are reproduced in Table 10, previously referenced.

The Boston area is best known for its universities and colleges. Not only is it the home of institutions of learning of the highest international standing, but it has a very high number of colleges. These in turn have spawned a large number of research firms, firms manufacturing advanced technical equipment, and specialized consultant firms of national and international repute. This is reflected in Table 11 where earnings from professional services, which includes university staff and consultants, are projected as 18.2 percent of total earnings in 1980, as compared to the national average of 12.0 percent.

Boston Harbor is not the site, and is unlikely to become the site, of modern industries such as steel, petroleum refineries, and petrochemicals which favor locations with direct access to port facilities.

When it is considered that other traditional New England labor intensive industries such as textiles have also declined, it can be seen that Greater Boston's continued prosperity depends greatly on attracting firms in advanced technology who wish to tap the pool of highly skilled professionals available in the area. Professional manpower is highly mobile and will prefer to locate in an area where they can find social, cultural, and recreational opportunities to suit their taste.

Boston, with its many local and regional historical associations, also has a major potential as a tourist center, which can be fully realized on completion of the urban renewal presently underway.

Port related activity in Boston Harbor is also a major constituent to the economy of the study area. The waterfront commercial activity within Boston Harbor consists of many diverse sectors ranging from charter passenger services to the receipt of LNG shipments. Because of the nature of this study, the remainder of this discussion, will concentrate on port related economic activity and facilities.

In terms of waterborne commerce, Boston Harbor is the largest port in New England. In 1984, total waterborne commerce for the port was 19,888,675 short tons. Of the total volume of waterborne commerce in 1980 approximately 88 percent was liquid petroleum products and the remaining 12 percent was containerized and break bulk cargo. The growth of the port is detailed in Table 12.

TABLE 12

COMPARATIVE STATEMENT OF TRAFFIC

Year	Bulk	Passengers	Year	Bulk	Passengers
1967	21,549,086	264,358	1976	26,172,442	724,477
1968	22,610,760	213,565	1977	25,975,275	628,921
1969	24,818,746	314,115	1978	26,073,590	238,499
1970	26,867,918	76,730	1979	26,342,672	260,464
1971	26,156,517	304,718	1980	22,033,922	113,235
1972	26,483,438	143,635	1981	20,306,450	365,117
1973	27,056,868	407,134	1982	17,593,627	393,483
1974	25,728,945	476,353	1983	17,036,478	49,420
1975	24,719,452	546,803	1984	19,888,675	395,131

Source: Waterborne Commerce of the United States, DA, COE

The great majority of the waterborne cargo handled in the Port of Boston is comprised of coastwise freight traffic, accounting for 54.3 percent of the total commerce in 1984. Of the 48.7 percent of domestic coastwise receipts, 88.7 percent of the commodities consisted of petroleum products transported from the refineries on the East Coast and the Gulf Coast. Table 13 shows the breakdown of waterborne traffic movements within Boston Harbor.

TABLE 13

WATERBORNE TRAFFIC MOVEMENTS, 1984

Foreign		Domestic	
Imports	38.5%	Receipts	48.7%
Exports	4.4%	Shipments	5.6%
		Local	2.9%

The tonnage of Boston's foreign trade for the period 1972-1984 is shown in Table 14. The foreign trade in the port fluctuated widely throughout this period, decreasing markedly during 1975, 1980 and 1982. Figures for years immediately following the down turn show an increasing trend toward the previous levels again. Based on this, the decline in tonnage was probably a result of the declining economic situation throughout the world, but with the upturn in 1976 a reversal of this situation is expected.

Imports constitute a large percentage of the foreign trade handled in Boston Harbor. Table 15 lists the major commodities imported and exported through Boston. Of the petroleum products imported into Boston Harbor, about 40 percent is distillate fuel oil. The imported petroleum products account for about 38 percent of the total petroleum products moved through the port.

TABLE 14

BOSTON'S FOREIGN TRADE TONNAGE

Year	TONNAGE Exports	Imports	Total	PERCENT CHANGES Exports	Imports	Total
1972	757,707	7,872,977	8,630,684			
1973	816,240	10,189,201	11,005,441	8	29	28
1974	881,339	8,397,307	9,278,700	8	-18	-15
1975	546,592	5,987,864	6,534,456	-38	-29	-30
1976	534,599	7,133,685	7,668,284	-2	19	17
1977	501,847	7,547,246	8,049,093	-6	6	5
1978	794,267	6,712,290	7,506,557	58	-11	-7
1979	852,353	7,302,197	8,154,550	7	9	9
1980	835,615	5,912,062	6,027,677	-2	-29	-26
1981	578,641	6,778,460	7,357,101	-31	31	22
1982	497,916	4,740,215	5,238,131	-14	-30	-29
1983	623,046	5,397,293	6,020,339	25	14	15
1984	876,659	7,655,355	8,532,014	41	42	42

SOURCE: Waterborne Commerce of the United States

TABLE 15

TEN LEADING COMMODITIES IMPORTED INTO BOSTON - 1984
(FOREIGN)

	Short Tons
Petroleum Products	5,741,525
Liquified Gases	871,168
Sugar	209,291
Salt	174,048
Gypsum	163,800
Motor Vehicles, Parts, Equip.	96,214
Alcoholic Beverages	58,266
Newsprint paper	51,153
Fresh Fish	43,420
Plastic Materials	17,297

TEN LEADING COMMODITIES EXPORTED INTO BOSTON - 1984
(FOREIGN)

	Short Tons
Ferrous Scrap	782,876
Paper Waste and Scrap	23,950
Gasoline	8,998
Paper & Paperboard	7,488
Animal By-Products	4,355
Chemicals and Products	4,316
Machinery Except Elect.	4,251
Lumber	3,848
Nonferrous Metal Scrap	3,426
Instruments, Time, Photo, Optical Goods	3,407

SOURCE: Waterborne Commerce of the United States, ACE

The arrival of vessels having drafts greater than 18 feet are detailed in Table 16. The total number of unassisted self-propelled vessel arrivals for 1979 having drafts greater than 18 feet represent approximately 16 percent of the total vessel arrivals recorded. The total number of trips for vessels inbound and outbound with drafts at least 20 feet is shown in Table 17.

TABLE 16

VESSEL ACTIVITY IN THE PORT OF BOSTON

	ARRIVALS						
	1972	1973	1974	1975	1976	1977	1978
Bulk Carriers	225	235	132	129	120	126	134
Break Bulk, General Cargo	480	401	196	140	160	137	141
Fully Containerized, General Cargo	163	244	276	272	279	262	265
Passenger	36	53	24	19	9	8	8
Tankers	635	665	633	571	583	628	542
Other	10	31	19	32	24	29	38
TOTAL	1,549	1,629	1,280	1,171	1,175	1,190	1,178

SOURCE: Massport

	ARRIVALS			
	1979	1980	1981	1982
Bulk Carriers	118	118	106	92
Break Bulk, General Cargo	117	134	119	107
Fully Containerized, General Cargo	284	289	291	277
Passenger	14	25	28	21
Tankers	548	440	427	337
Other	38	27	30	27
TOTAL	1,119	1,033	1,001	861

SOURCE: Massport

Of the deep draft vessels, characterized as having drafts greater than 30 feet, that arrived in the port approximately 63 percent went to the main waterfront (including the Reserved Channel), 25 percent to the facilities on the Chelsea River, and 12 percent to the Mystic River.

TABLE 17

TRIPS AND DRAFTS OF VESSELS IN BOSTON HARBOR
(Inbound and Outbound)
1960-1979

DRAFT (Feet)	1960	1965	1970	1975	1976	1977	1978	1979
41-45		3	1	3				
36-40	24	53	214	195	218	226	206	219
31-35	438	440	477	368	396	427	371	370
26-30	669	500	483	598	649	667	590	675
20-25	2,135	2,074	1,622	1,051	1,028	826	704	743
TOTAL	3,266	3,067	2,799	2,213,	2,294	2,146	1,871	2,007

SOURCE: Waterborne Commerce Statistics ACE

TRIPS AND DRAFTS OF VESSELS IN BOSTON HARBOR
(Inbound and Outbound)
1960-1984

DRAFT (Feet)	1980	1981	1982	1983	1984
41-45					
36-40	127	122	76	77	131
31-35	311	314	292	264	210
26-30	638	705	677	539	455
20-25	667	669	711	710	752
TOTAL	1,743	1,810	1,756	1,590	1,648

SOURCE: Waterborne Commerce Statistics ACE

There are six deep-draft general cargo marine terminals in the Port of Boston with berthing capacity to accommodate up to 30 ships. The Boston-Mystic Public Container Terminal located at the J.F. Moran Docks in Charlestown is a 44-acre facility capable of loading and unloading the largest containerships. Castle Island Terminal, Commonwealth Pier, and the Boston Army Base Pier, all located in South Boston, provide a 35-foot depth at MLW for docking vessels. The Mystic Pier, located in Charlestown, has the capacity for four deepwater vessels for container or bulk cargo operations. Pier 1 of the East Boston Terminal complex is of recent construction and a focal point in the development of the new Port of Boston. In 1973, 90 percent of the cargo handled at this facility was break-bulk.

In addition to these deep-draft general cargo handing terminals, 12 facilities handle petroleum liquid bulk, 3 handle dry bulk, and 2 facilities located in Charlestown operate sugar refineries. A summary of the piers, wharves and docks by purpose for which used or service offered is detailed in Table 18.

In terms of tonnage, the second largest commodity imported into the Port of Boston is liquified gas. In 1976, a total of 459,928 short tons of LPG (propane) and LNG (methane) was received. The Exxon Company, U.S.A. and Distrigas of Everett, and the Boston Gas Company in Dorchester have facilities equipped to receive liquified gas shipments. However, the Boston Gas Company facility is restricted by channel depth and has not received an LNG shipment in recent years.

The shipbuilding and repair industry in Boston Harbor is another major facet of the port's commercial activity. The largest and best equipped ship repair and conversion plant in New England is the Bethlehem Shipyard in East Boston. A second East Boston yard, the Boston Shipyard Corporation is located on Jeffries Point. In addition to these facilities, the General Dynamics Shipyard, located in Quincy, is one of the largest and most diversified shipyards in the U.S. This facility

encompasses over 181 acres of Quincy along the Fore River. While this yard is currently closed, a proposal to sell the facility to a consortium of former shipyard workers is under consideration. A fourth major facility, the General Shipyard Corporation is located in South Boston along the 40-foot deep main ship channel. This facility operates the former South Boston Naval Annex Drydocks #5 and #3. Three other facilities, the Bromfield Corp., General Ship and Engine Work, Inc., located in East Boston, and the Munroe Drydock, Inc., in Chelsea, perform complete ship repair and conversion work.

TABLE 18

THE PORT OF BOSTON, MASSACHUSETTS

Purpose of Which Used	No.	
Cargo handling:		
Bulk cement	2	
Chemicals, petrochemicals, and solvents	1	
Construction materials and equipment	1	
General cargo - in foreign and domestic trades	17	(1)
Gypsum rock, liquid sulphur, and sulphuric acid (one each)	3	
Petroleum products	29	
Raw sugar	2	(2)
Refuse	2	
Salt	2	
Steel, steel products, and scrap metal	3	
Seafood	9	
Vegetable oil, liquid caustic soda, and silicate of soda	1	
Marine Services and Repairs:		
Mooring	37	
Mooring in connection with repairs, conversions, and outfitting	31	
Not used for handling waterborne commerce	4	
Unused facilities at time of survey	12	
TOTAL	156	

(1) One is a containerized, general cargo terminal, and 3 also handle containerized cargo

(2) One also receives fuel oil for plant consumption.

Commonwealth Pier, located in South Boston, is the only major passenger ship pier in Boston. In 1979 the passenger volume was 260,464 persons. In addition to this facility, two facilities provide sightseeing and charter excursion services around the harbor. A passenger ferry provides transportation from Deer Island to Provincetown on Cape Cod, Massachusetts during the summer months.

Boston Harbor, within one of the major metropolitan areas of the Atlantic seaboard, is served by an extensively developed highway system. A series of Interstate and State routes provide overland access to major points along the entire Atlantic seaboard as well as major inland distribution destinations. State Route 128, now designated for most of its length as Interstate 95, is a multi-lane divided highway providing circumferential access around the metropolitan area. Interstates 95 and 93 provide overland access to all points in Maine and New Hampshire to the north, and to all points as far south as Florida. Interstate 90, the Massachusetts Turnpike provides overland access westward across the state to the New York State line and thence continues to its terminus in Seattle, Washington. Additional principal numbered highways serving the area include State Routes #2, #3, #9, #24, and #138 and U.S. Routes #1, #3, and #20.

Boston Harbor is the terminus of two long-haul rail carriers, the Boston and Maine, and the Pennsylvania Central Railroads. The Boston and Maine Railroad serves cities and towns north of Boston and west of Worcester. The Pennsylvania Central Railroad provides passenger and freight service west through the major central points of the state into Albany, New York and to the south and southwest to Connecticut and Rhode Island and direct lines to New York City.

Overseas steamship services are provided by some 30 steamship lines operating in the Boston area. These services extend to virtually all parts of the world, linking Boston with nearly 150 world ports.

The principal air facility in the area is Boston's Logan International Airport. This facility encompasses about 2,000 acres of filled-in land extending into Boston Harbor, and is the closest of any metropolitan airport in the U.S. to its downtown district. Other commercial airports in the area include: L.G. Hanscom Airport in Bedford, Beverly Municipal Airport, Danvers Airport, Norfolk Airport and Norwood Municipal Airport. The Massachusetts Port Authority operates both Logan and Hanscom Airports.

The Port of Boston will continue to provide sea transportation services as New England's major commercial center in waterborne trade, if cargo handling efficiency, shipping services, storage facilities, and major inland markets continue to adapt to the commerce demands. The future of Boston's port activity will depend upon its ability to provide deepwater and safe passageway for vessels entering and exiting the port.

Boston is and probably will continue to be New England's major oil port. The trend of fossil fuel consumption to meet the region's energy demands is expected to continue until alternate energy sources are developed. The construction of pipeline systems to transport petroleum products from the major sources, primarily the Gulf, to the region have been rejected as economically and environmentally infeasible, therefore,

the future activity of the port will continue to lie in the receipt of petroleum products. Growth in the non-petroleum industries is expected to be nominal.

One of the major commercial and industrial plans for the Port of Boston is for the redevelopment of the site of the South Boston Naval Yard site. Massport has presented a proposal for the complete redevelopment of the site as a container terminal (A Proposal for the Development of Container Terminal at the South Boston Naval Annex and Army Base. Second draft, January 1977, Massport). This plan would also involve the conversion of the existing Moran Container Terminal, on the Mystic to a bulk facility. The city of Boston's Economic Development and Industrial Commission (EDIC), however, argues that a major portion of the site be redeveloped for industrial purposes, providing much needed employment in Boston.

There is also a plan for the modernization and rehabilitation of the Boston Fish Pier, the center of all fishing transactions for the Boston metropolitan area. However, plans for the structural improvements of this facility, have not been fully approved to date. A Foreign Trade Zone (FTZ) in Boston Harbor, authorized by the U.S. Department of Commerce in April 1977, is planned to be constructed on 5.1 acres within the Boston Marine Industrial Park. This FTZ is the first in New England. This facility will employ people engaged primarily in light manufacturing, assembly, and packing.

The 1965/1975 city of Boston General Plan (Boston Redevelopment Authority, 1964) identifies the upper shoreline of the Chelsea River in East Boston as an area for redevelopment for industrial use. Part of this area has also been identified as a conservation area under the Boston Urban Wilds Program.

The major plan for waterside redevelopment focuses on the Charlestown Navy Yard. The yard was decommissioned in 1974 after 174 years of military service. The plan calls for the redevelopment of mixed uses, including a historic monument area, public park, and also a mixed use area including industry, hotel conference center, offices, housing, and a marina.

The 1965/1975 General Plan for the city of Boston indicates the intention of redeveloping much of the East Boston waterfront for residential purposes. To date, Shore Plaza East, a 380-unit low and moderate income apartment complex, and a new school have been completed on Border Street. There are plans for mixed housing, commercial, and open space development of the waterfront below Maverick Square.

F. Environmental Consequences

1. Dredging Site

a. General

The proposed improvement dredging will occur over a 17-month timeframe. The activity will generate high turbidities, destroy finfish and shellfish in the vicinity of the blasting activity, and suspend particulates with adsorbed chemical contaminants. Those non-mobile organism that inhabit the substrate will be destroyed. Those highly motile organisms transiting the project area will be displaced, avoiding the dredging and blasting activity. All of these impacts will be spatially and temporally limited to the length and areal extent of the proposed activity, with subsequent benthic infaunal recovery probable within one to two years of project completion. The post-dredging environment will therefore quickly return to the present conditions.

b. Physical and Chemical Effects

The dredging of sediments from the proposed channel will resuspend sediments that are excavated and overflow the dredge bucket. This sediment suspension will result in increased sediment load in the water column. The underlying sediments exposed will be temporarily unstable and oxygen depleted at the sediment/water interface. Subsequent physical and biological activity will stabilize and oxygenate the substrate over time. The channel deepening will ultimately result in a minuscule alteration in flushing rate given the 150 billion gallon plus diurnal tidal prism.

With the explosive fracturing and mechanical removal of approximately 50,000m^3 of bedrock, the potential to kill fish and invertebrates exist. Based on known information (e.g. rock density, anticipated explosive size during a single blast, open water fish kill research, physical characteristics of the harbor) an estimated fish kill zone during blasting activities would range from 30m^2 to 1400m^2 surface area. Based on this study's limited fish density data (two seasons of fish trawls and gill net collections) the average is approximately 10 fish/m^2. If at any given time the fish were present in the water column directly over the blast and orientated sideways to it, the maximum moralities may range from 300 to 14,000 fish per blasting operation. These numbers of fish kill are not significant in terms of the harbors ecosystem.

Mechanical bucket dredging activities excavate a majority of the substrate in a cohesive mass; only a small percentage of the dredged material becomes suspended in the water column. This suspended material is restricted to the silt or clay fraction (>4 phi) with sand particles (<4 phi) settling out immediately after suspension. Grain size analyses of 21 stations (see Appendix I) identify the substrate as 86.5% fine grained, 2.3% rock and the remaining material sand.

Bohlen (1979) analyzed the effects of mechanical dredging of a silt/clay substrate in New London Harbor, Connecticut. This research concluded the effects of suspended silt on water quality to be of short duration and localized to the immediate dredge site. While suspended, silt increases water turbidity levels. High turbulence reduces vision and masks odors important to foraging organisms. Suspended silt may also clog or abrade gill structures and interfere with the feeding mechanisms of filter feeders. Chemical signals important to anadromous migrations may also be interfered with. The usually high organic content of silt/clay material may depress ambient oxygen concentrations, but chemical oxygen demand averaged for all 21 stations averaged 80,509 ppm (S.D. = 44,500) for surficial samples (a moderate value). The lean Boston Blue Clay layer (approximately 80% of the material) would not exert an oxygen demand on the water column because "lean" clay by definition does not contain organic materials. Increased turbidity would reduce light penetration lessening primary productivity and therefore oxygen release from photosynthetic processes could be reduced. Finally, upon settling, the suspended sediment load, both sand and silt/clay could cover non-motile organisms (see C. Biological Effects). All of these effects are expected to be spatially and temporaly limited to the immediate area of the dredge and length of the activity.

During various dredging operations, scientific analysis of the spatial and temporal persistence of the turbidity/organic plume has been quantified. In the summer of 1977 the extent and duration of the impacts from dredging the Thames River/New London Harbor channels were studied (Bohlen et. al., 1979). This material was predominantly silt/clay (>4 phi). The conclusions of this study defined the plume of suspended materials from the dredging operation as having a maximum extent of 700 meters downstream. Analysis of the composition and concentration of the plume indicated the majority of material suspended occurred within 30m of the dredge. Suspended material concentrations were reduced by a factor of ten within the first 200 meters downstream of the dredge. Mid-water and near bottom concentrations returned to background levels 700 meters downstream of the dredge. All values were significantly less than storm induced perturbations that occur on an average of 1 to 3 times yearly in that harbor.

All of the effects associated with increased turbidity in Boston Harbor would occur in the immediate area of the dredge, be transported by currents and settle. After completion of the dredging activity, these impacts will cease. The motile organisms will escape this downcurrent sedimentation impacts by leaving or avoiding the activity area. The remaining organisms will be impacted. These organisms are estuarine species that are tolerant of recurring turbidity stresses (see C. Biological Effect).

One of the functional characteristics of an estuarine system, such as Boston Harbor, is to serve as a nutrient retention area, increasing the productivity of its subcomponents. Nutrients are

effectively "trapped" in the sediments were they are stored. This trapping and storage function also allows for the retention of pollutants in the same substrates, especially in fine grained sediment which have a larger volume of surface area for pollutant adsorption. The physical removal of these sediments by dredging operations has the potential to release some of the sediment bound pollutants.

One group of pollutants that have been of concern for environmental quality analyses are metals such as mercury (Hg), cadmium (Cd), chromium (Cr), lead (Pb), copper (Cu), and zinc (Zn). Recent studies have shown that even when metals are found in high concentrations, there does not exist a corresponding substantial release of free (non-bound) metals from resuspension of bottom sediments during dredging. Studies performed by the Corps of Engineers Dredged Material Research Program conclude that certain trace metals may be released in the parts per billion (ppb) range, while others show no release pattern (Chen, 1976). Chen (1976) also showed that heavy metals are not readily soluble or excessively mobile through a trophic system since they are usually adsorbed to sediments or coprecipitated out of solution.

Other classes of toxicants that are of concern are PCB's (Polychlorinated Biphenyls), PAH's (Polycylic Aromatic Hydrocarbons) and DDT (Dichloro-Diphenyl-Trichloethane: a chlorinated pesticide). The presence of these chemicals were analyzed by various testing as described in Section E of this report. Bulk et. al. (1975) demonstrated the solution of pesticides from bottom sediments into the water column during dredging is not significant. Polycyclic Aromatic Hydrocarbons (PAHs) are a by-product of industrialization of estuarine areas and are detrimental to the ecosystem only when released in very high concentrations. The concentrations of PAH's in the proposed project area will be analyzed using the recently described two-tier biassay/sediment chemistry testing system (Clarke and Gibson, 1987) when all materials are subjected to bioassay/bioaccummulation testing (see Section F.2.c). Although high (3.0 ppm) levels of PCB were only found in the Mystic River (only one analysis - Station B), additional sediment testing for PCB levels will be conducted in conjunction with the bioassay/bioaccummulation procedures. Elutriate analyses of the surficial material (see Section F.2.b.) indicates PCB may be released from the sediments during disposal, but mechanical dredging should allow minimal elution potential at the dredging site.

The dredging of the channel would remove a majority of the substrate in a cohesive mass, prohibiting the possibility of elutriation of all contaminants. A review of the low levels of sediment chemistry (as an average), the ambient water quality and the use of a bucket or clamshell dredge, indicates no potential exists for significant degradation of ambient water quality (given its present state) during dredging. After project completion the benthic substrate of the Boston Harbor ecosystem will be slightly less contaminated due to the removal of these sediments.

c. Biological Effects

The primary impact of this project on biological resources will be to remove the benthic organisms inhabiting the areas to be dredged. As described previously, this impact will represent a loss of from 4,797.8 organisms per square meter from 8 species/m^2 to 28.7 organisms per square meter from 0.4 species/m^2, depending on the season. Dredging will expose azoic lean clay and rock substrate to be recolonized (adult and larval) by benthic organisms. During the recolonization period, there will be a large number of individuals from a few benthic species. Subsequent populations will recruit a greater number of species, having fewer individuals. Concurrent with this transitional state the substrate will be biogenically reworked until it becomes properly aerated and suitable for colonization by more species. It is this large number of pioneering benthic species that biogenically rework the substrate in a short time frame. These organisms are also an important source of forage for juvenile finfish. In Boston Harbor, seasonal depletion of the water column oxygen levels maintain the benthic community of the inner harbor as a pioneering assemblage in a state of dynamic equilibrium (see E1.c. Biological Environment). The dredging of the channel will cause a short term loss of benthic productivity that will be rapidly offset through faunal recolonization.

Chemical signals essential for anadromous fishery migrations may become masked by the dredging operation's suspension of sediments and associated chemicals. This interference would only occur in the immediate area of the dredge. Dredging will be scheduled in non-sensitive areas of the harbor to avoid impacting seasons of critical spawning runs of those species listed in Table 8 (also see G. Mitigation).

Photosynthetic processes and associated productivity will be decreased during high periods of turbidity. This reduction in primary production will be temporary. Sediment suspension will also displace motile species avoiding gill abrasion, lower oxygen levels and reduced sensory opportunities for predation (masked odors and low visibility) in the dredging area. These would all be temporary and insignificant effects given the recommended mitigation practices (see G. Mitigation).

2. Disposal Site

a. General

The Foul Area Disposal Site (FADS) annually receives approximately 300,000 cubic yards of dredged material. In 1981-2, maintenance dredging of Boston Harbor and vicinity generated approximately 2 million cubic yards of dredged material that was disposed at this site. The estimated 2 million cubic yards of dredged material from this project will therefore be of similar characteristics to most of the substrate at FADS.

The material dredged from the proposed channels will be placed on barges and transported (approximately 1500 trips) to the Foul Area Disposal Site (see Figure 4). The disposal will occur by bringing the barge to a complete stop at the predescribed point. This disposal point will be marked by a buoy positioned by the New England Division of the Corps of Engineers. The discharge will occur in approximately 100 meters of water.

This site has been extensively studied by the New England Division. Precision bathymetry, sediment grab sampling and REMOTS image analysis (sediment profiling) have characterized this site as a low energy environment suitable for dredged material disposal and containment. Additional oceanographic sampling is currently being conducted in reviewing the interim ocean disposal site status of this site.

b. Physical and Chemical Effects

A turbidity plume will be created by the disposal of the dredged material. The release of contaminants adsorbed to these sediments may proportionally correspond to those values determined by the chemical testing. The values will be considerably less for the turbidity plume, since most of the material will remain consolidated. This impact on the disposal site will be short lived.

After the dredged material is released from the barge, it descends through the water column and some of the chemicals adsorbed to the fine particulates are eluted from the dredged material. To estimate the potential concentrations of the eluted chemicals, an elutriate test was performed on sediment samples from the project area. This test was conducted in accordance with the guidelines established in the joint Environmental Protection Agency and Corps of Engineers document: "Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters" (1977). This test mixes one part sediment sample with four parts seawater and agitates the slurry for 30 minutes. The sample is allowed to settle and the supernate is drawn off and analyzed. Three replicate analyses are performed on each supernate. The results of this testing is included in Appendix I and summarized below. These results contrast ambient water column values to the test data.

Elutriate analysis of the surficial sediments from Mystic River Station B indicated the potential release of sulfate (2146.7 ppm, S.D.=255.8); oil and grease (7.7 ppm, S.D.=5.51); phosphorus (total and ortho) (0.537 ppm S.D.=0.160); lead (7.87 ppb, S.D.=1.50); arsenic (15.0 ppb, S.D.=2.27); chromium (3.23 ppb, S.D.=1.76); silver (1.3 ppb, S.D. = 0.7) and PCB (2.21 ppb, S.D.=1.71) above dredge site ambient conditions. All of these releases are in low concentration and well below the EPA Water Quality Criteria (EPA, 1986) except for PCB. The tests performed throughout the rest of the project area exhibited similar results, with lower concentrations of PCB.

The Inner Confluence area Station B exhibited release of oil and grease (2.7 ppm. S.D.=2.9); zinc (4.3 ppb S.D.=4.0); arsenic (2.4 ppb, S.D.=0.38); chromium (1.17 ppb, S.D.=0.29); silver (0.77 ppb, S.D.=0.38); PCB (0.06 ppb, S.D.=0.05), barium (6.10 ppb, S.D.=35.9); and beryllium (0.68 ppb, S.D.=0.97). Only PCB has the potential to be released above the EPA Water Quality Criteria.

The Chelsea River elution potential was measured from samples taken at Stations B and F. Station B exhibited the potential to release sulfate (2243.3 ppm, S.D.=100.2); ortho- and total phosphorus (0.21 ppm, S.D.=0.08); mercury (0.9 ppb, S.D.=0.26); lead (6.47 ppb, S.D.=7.0); arsenic (3.0 ppb, S.D.=1.5); cadmium (0.1 ppb, S.D.=0); PCB (0.07 ppb, S.D.=0.07), and barium (149 ppb, S.D.=6.1) above ambient. Station F exhibited potential elution of ortho- and total phosphorus (0.10 ppb, S.D.=0.01); mercury (1.23 ppb, S.D.=0.32); arsenic (2.97 ppb, S.D.=1.5); cadmium (0.43 ppb, S.D.=0.58); copper (1.33 ppb, S.D.=0.58); and beryllium (131.3 ppb, S.D.=6.1). As in other project areas, all concentrations are low and/or below EPA marine water quality standards except for PCB, which was elevated (0.15 ppb) for only one replicate.

The Reserved Channel elutriate analyses indicated release of oil and grease (2.5 ppm, S.D.=2.1); ortho and total phosphorus (1.25 ppm, S.D.=0.43); mercury (0.67 ppb, S.D.=0.29); arsenic (10.3 ppb, S.D.=4.5); chromium (2.6 ppb, S.D.=0.92); copper (1.67 ppb, S.D.=1.16); silver (1.33 ppb, S.D.=0.72); PCB (0.13 ppb, S.D.=0.05); and barium (109.7 ppb, S.D.=60.3) above ambient. Again, only PCB is above the EPA criteria and all other values are relatively low.

A dilution zone calculation (EPA/COE, 1977) was performed for PCB to predict disposal site impact of contaminant release in these concentrations. Using the Mystic River average site B PCB elutriate potential of 2.21 ppb (S.D.=1.71) the calculation revealed PCB concentrations will meet the EPA Water Quality Criteria of 0.03 ppb within 2.5% of the initial mixing zone (approximately 5.90 x $10^6 m^3$) and this volume represents 0.014% of the waters within the Foul Area Disposal Site. This disposal, therefore, will not have a significant impact on the quality of the water column at the Foul Area Disposal Site.

Recent studies (DAMOS, 1985) concluded the concentration of suspended materials in the turbidity plume, following disposal, will be no greater than 5 to 12 mg/l forty minutes after disposal. These studies were conducted at the Foul Area Disposal Site in Massachusetts Bay with hydraulically dredged material disposed in 100 meters of water. This method of dredging mixes the sediment with water to form a slurry. The disposal of this mixture represents the maximum possible suspension of material. The bucket dredging technique to be used for this project will maintain the disposal sediments in a cohesive mass, greatly reducing turbidity potentials.

The disposal site has been used for dredged material and various waste disposal for a number of years. The process of disposing sediments at this site buries the organisms inhabiting the site. This burial process has been of sufficient frequency at the Foul Area Disposal Site to maintain a disturbed environment at the point of disposal. A specialized population of benthic species have successfully exploited this disturbed niche and rapidly provide biomass and bioturbation to the newly disposed material. These pioneering organisms are already established on the disposal site (DAMOS, 1985) and their action will quickly rework the newly deposited sediments. This process will not alter the chemical environment of the substrate since previous significant disposal operations have been required to analyze these sediments to fulfill the same criteria as this proposed dredging project. The low overall concentrations of contaminants from the project will not adversely affect the present chemical environment of the disposal site. As stated earlier (E. Affected Environment) the material to be dredged is generally Category I- III silt over Category I clay, that if homogenized would average to Category I level. In general the Foul Area Disposal Site contains Category I, II, and III sediments. Disposal of the project sediments should not adversely affect the FADS chemical environment.

Physical parameters such as currents, waves, and tidal circulations have been closely monitored for the site (DAMOS, 1985). This area has contained dredged material on site and does not disperse sediment or chemicals to affect ambient environments. In general, the proposed disposal of an estimated 2.4 million cubic yards of material dredged from the project area will not significantly impact the disposal site given its physical, chemical and biological characteristics and general history of use.

c. Biological Effects

The disposal of dredged sediments will bury those non-motile and larval/juvenile organisms at Foul Area Disposal Site that have inhabited the previously disposed material. The same pioneering species will quickly inhabit the newly disposed material by larval and adult recruitment. The overall process of maintaining a disturbed habitat will provide a productive benthic environment for organisms that will rework the substrate. This biological mixing of the substrates (bioturbation) will homogenize and oxygenate the upper few centimeters of the sediment. This will allow other organisms to begin inhabiting the substrate (colonization). Larvae will settle and metamorphize and adults will emigrate into the area, all contributing to restore benthic productivity.

To date, specific testing for bioassay/bioaccummulation of dredged material contaminants has not been performed on material from the proposed project areas. Biossay and bioaccumulation studies will be performed after project authorization and funding to determine if the dredged material will have a detrimental impact on the biota of the disposal site due to chemical constituents of the disposed sediment. The result of this

testing will be used to determine the acceptability of this material for ocean disposal under Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1401 et seq). All analysis procedures will be in accordance with the guidelines established by the Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (1977).

The bioassay and bioaccumulation tests provide an indication of the chemical effects of the substrate on organisms that come in contact with it. The bioassay procedure exposes and monitors the mortality of the organisms. Although bulk chemical testing identifies sediment contaminant levels, the bioassay testing procedures assesses the toxicological impacts of the entire complement of chemicals, accounting for synergistic effects and undetected chemical metabolites. The survival rates are calculated for the dredge material and a suitable reference site. The statistical analysis of the results provide an indication of the sediment toxicity to the biota. The bioaccumulation tests define the amount of chemicals that have been bioconcentrated in the body tissue of the organisms from contact with the substrate along with chemicals ingested through feeding activity. These accumulations are reflected in the body tissue concentrations of the surviving tests organisms. Typical organisms analyzed are the crustacean, Palaeomonetes pugio, the hard clam, Mercenaria mercenaria, and the sand worm, Nereis virens.

The bioassay results exhibit survival ranges of the separate and combined species in the control aquaria. This indicates that laboratory procedures and equipment, as well as organism health, are of sufficient quality to allow for comparison of the test and reference results. The solid phase results for separate and combined species show either greater survival for the test organisms in contrast to the reference organisms, or where the reference survival rate is greater, the difference will be reviewed for statistical significance ($p < 0.05$) according to the EPA/Corps (1977) Implementation Manual. The tissue of the organisms surviving the 10-day bioassay test will be analyzed for uptake of cadmium, mercury, polychlorinated biphyenyls, DDT and Polycyclic Aromatic Hydrocarbons (PAH's) at a minimum. The evaluation of these test results will indicate any adverse impact upon the environment and if the dredged material is suitable for ocean disposal.

Most of the material proposed to be dredged is pristine clay with some silts accumulated on the surface of the substrate. Based on the preliminary review of the chemical composition of this material, it appears a majority of the material will be suitable for ocean disposal. The Foul Area Disposal Site is the closest ocean disposal site and it has the physical capacity to contain the material. This preliminary review of the chemical composition of Boston Harbor indicates bioassay and bioaccumulation testing will be required according to PL 92-532. Recently, these tests have been performed on similar Boston Harbor material for various ocean disposal permits that have been issued. Since the tests are sensitive to synergistic effects of all contaminants present in the dredged material, one set of tests are not explicitly applicable to

another proposed dredging site. Table 19 lists the 1986 chemical composition of the surficial sediments in the Mystic River proposed improvement dredging sampling program and the 1986 chemical composition of material for a private dredging project permitted for ocean disposal after conducting bioassay/bioaccummulation testing. In a general sense, the materials are similar in chemical composition. There was some uptake of contaminants by marine organisms exposed to the Mystic River Permit Applicant samples, but it was determined the be within acceptable levels by NED and EPA. The testing of the proposed improvement dredging material may be expected to yield similar results. It may be considered acceptable for ocean disposal after testing and with proper disposal management (e.g. capping) it should pose no threat to the marine environment. The removal by dredging and isolation at the disposal site of this contaminated material will enhance the environmental quality of Boston Harbor by preventing the resuspension of the contaminated material by storms and propeller-induced turbulence, and effectively isolating this material in a quiescent environment.

Table 19 Boston Harbor Sediment Samples (March - April 1986)
New England Division

Location	Physical Description	% Fines	Oil/Grease (ppm)	Heavy Metals I	II	III	PCB's (ppb)
A	Organic Clay	90	4300 (II)	3	3	3 (Pb,As,V)	
B	Organic Clay	87	4400-5300 (II)	1	4	4 (Pb,Zn,As,V)	3000 (III)
C	Lean Clay	95	53 (I)	9	0	0	
D	Clayey Sand	33	1000 (II)	8	1	0	
			Permit Application Data - Mystic River - 1986				
Mystic River							
A-Permitee		89	1100(I)	4	2	2 (Pb,As)*	LT500
B-Permitee		70	4399(II)	2	3	3 (Pb,Zn,As)*	4300(III)

*Vanadium was not analyzed by the Applicant

3. Threatened and Endangered Species

There are no Federally listed threatened or endangered species known to inhabit the dredging site. Cetaceans are transients of the disposal site, but are currently assumed by NED not be to impacted by ocean disposal. If any transient endangered species entered the area during the project operation, they would avoid the dredging or disposal activity. Since all impacts on the environment are temporally and spatially limited, impacts on the food sources of these species are also assumed minimal. Consultation will be initiated with the National Marine Fisheries Service under Section 7 of the Endangered Species Act of 1973 (as amended, 16

U.S.C. 1531 et seq.), to ensure this activity will not jeopardize any endangered or threatened species after completion of the bioassay/bioaccumulation testing.

4. Ecologically Significant Species

Potential impacts to ecologically significant species include interference with movements of anadromous finfish (predominantly in the spring) to freshwater spawning areas, interference to winter spawning flounder, disruption of lobster habitat and removal of benthic communities. To avoid impacting the anadromous fisheries runs, seasonal avoidance of dredging activities in the migratory pathway regions of the project could be implemented. (See G. Mitigation). Winter flounder spawning grounds and lobster habitats are not expected to be significantly impacted given the ability of these organisms to avoid the project area during active dredging. The macrobenthic dominants (Capitella capitata and Streblospio benedicti) can be expected to recolonize the newly exposed substrate of the dredged area within a few weeks to months after dredging.

5. Historic and Archaeological Resources

The dredging portion of the navigation improvement project in Boston Harbor will have no effect on any site of historic, architectural or archaeological significance, as defined by the National Historic Preservation Act of 1966. The Chelsea Street Bridge is considered to be eligible for the National Register of Historic Places, as it is the only bridge of its type known to survive in the Commonwealth. Any modification to the bridge would require coordination with the Massachusetts Historic Commission to outline mitigation measures.

6. Social and Economic Resources

The improvement dredging project would have no effect on natural or human resources in the project area. However, it will have some effect on the local economy through anticipated transportation savings of $5,313,000 annually for a 40-foot channel. It is not anticipated that the improvement project would result in increased tonnage shipped through the port of Boston. The project should result in somewhat fewer trips, but larger vessels will be utilized in transporting cargo to Boston.

G. Mitigation

The proposed dredging and blasting activities will remove organisms associated with the substrate, potentially interfere with anadromous fisheries movements, increase turbidity levels, resuspend or elute sediments with adsorbed contaminants (e.g., lead and PCBs) and destroy finfish and shellfish in the vicinity of the blasting shockwave. Disposal of the project material will elute silts and sediment adsorbed contaminants into the water column, bury organisms, and leave a physical and chemical signature at the point of disposal.

The benthic inhabitants of the proposed dredging area are urban estuarine species tolerant of many environmental stresses. The removal of these organisms represents a temporary loss from the system in biological productivity, but within months recolonization should begin to occur in the dredged areas. The removal of the contaminated surficial sediments will ultimately benefit the ecological productivity of the system. No mitigation measures are anticipated for direct loss of productivity.

The anadromous fisheries movements through the project area are predominantly transient spawning runs that occur in the spring. Finfish that spawn in freshwater respond to chemical signals in the water column and transit the estuarine project areas travelling upstream to freshwater spawning regions. The Mystic River channel dredging has the potential to impact this anadromous migration. The dredging activity will increase ambient turbidity levels and release sediment adsorbed contaminants as the dredge bucket moves through the water column. This activity has the potential to degrade system productivity (primary and secondary). Restricting dredging of this channel to the months of October through February (see Table 7) will avoid impacting these sensitive resources.

The blasting and removal of rock will destory associated finfish and benthos. The potential exists for the use of the rock material for environmental enhancement. This material can be disposed in the northeast corner of the Foul Area Disposal Site to increase habitat niches there. That section of FADS is a ledge/cobble substrate where this type of artificial reef creation would diversify habitat niches, mitigating year round disposal impacts on benthos. Proper blasting techniques (e.g. minimize blasting during fisheries migrations) will minimize fish mortalities.

The transport and disposal of dredged material will be monitored by onboard disposal inspectors under contract to NED. Doors will be sandbagged so as not to leak out material and barges will not be overfilled resulting in overwash during transport. The inspectors will record the position of the barge at the time of disposal to ensure point discharges at a NED prescribed point. This type of disposal maintains a layering or capping of material, since the most contaminated materials will be disposed first followed by, and with, pristine clays. The rock/cobble barge loads could be disposed at an alternate buoy for habitat creation. These mitigation measures are in accordance with ongoing NED management practices of the Foul Area Disposal Site, isolation of contaminated dredged material and Corps policy for beneficial use of dredged material.

Chemical impacts on biota at the disposal site will be identified by bioassay/bioaccummulation testing. Even if impacts are identified, the above dredging and disposal sequence (Mystic River - Reserved Channel then Chelsea River) will allow the layering or capping of dredged materials with elevated contaminants by cleaner sediments.

An operational timing sequence (approximately 17 months) would be to dredge the Mystic River and Inner Confluence beginning in the fall and winter (October through February). Proceed by spring and through summer (March through October) to the Reserved Channel. Upper Chelsea River regions could be dredged at any time (e.g., once the Reserved Channel is finished and heavy winter petroleum shipments have lessened.) Any remaining work on the Mystic River and Inner Confluence areas would be finalized in October through February.

In summary, the dredging schedule could proceed year round with the above mitigation practices and not impart a significant environmental impact on the dredging or disposal site ecosystems.

H. Coordination

A public notice will be issued before dredging and construction. The proposed project and Feasibility Report has been coordinated with the following Federal and State Agencies:

Federal Agencies

U.S. Environmental Protection Agency
National Marine Fisheries Service
U.S. Fish and Wildlife Service

Commonwealth of Massachusetts

Department of Environmental Management
Department of Environmental Quality Engineering
Office of Coastal Zone Management
State Historic Preservation Officer
Response letters are discussed in Appendix III

I. Compliance

Boston Harbor Improvement Dredging
Compliance with Environmental Federal Statutes and Executive Orders

Federal Statutes

1. Preservation of Historic and Archeological Data Act of 1874, as amended, 16 U.S.C. 469 et seq

Compliance: Not Applicable; project does not require mitigation of historic or archaeological resources at this time.

2. Clean Air Act, as amended, 42 U.S.C. 7401 et seq.

Compliance: Submission of this report to the Regional Administrator of the Environmental Protection Agency for review pursuant to Sections 176c and 309 of the Clean Air Act signifies compliance.

3. Clean Water Act of 1977 (Federal Water Pollution Control Act Amendments of 1972) 33 U.S.C. 1251 et seq.

Compliance: Not Applicable; project does not involve the discharge of dredged or fill material into a wter of the U.S.

4. Coastal Zone Management Act of 1972, as amended, 16 U.S.C. 1431 et seq.

Compliance: A CZM consistency determination shall be provided to the State for review and concurrence that the proposed project is consistent with the approved State CZM Program, after all permits and licenses are obtained by the local sponsor. Preliminary correpondence indicates MCZM supports the project.

5. Endangered Species Act of 1973, as amended, 16 U.S.C. 1531 et seq.

Compliance: Coordination with the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) has occurred. Formal consultation requirements, pursuant to Section 7 of the Endangered Species Act, will be determined after bioassay/bioaccumulation testing results have been reviewed by the Services. NMFS and FWS have concluded that the improvement dredging will not impact any threatened or endangered species. They reserve final comment on the disposal impact until after the test results are available.

6. Estuarine Areas Act, 16 U.S.C. 1221 et seq.

Compliance: The Environmental Assessment describes pertinent estuarine impacts and coordination of this document with the U.S. Fish and Wildlife Service provides compliance with this Act.

7. Federal Water Project Recreation Act, as amended, 16 U.S.C. 4601-12 et seq.

Compliance: Public notice of the availability of this report to the National Park Service (NPS) and the Office of Statewide Planning relative to the Federal and State comprehensive outdoor recreation plans signifies compliance with this Act.

8. Fish and Wildlife Coordination Act, as amended, 16 U.S.C. 661 et seq.

Compliance: Coordination with the FWS, NMFS, and Massachusetts Division of Marine Fisheries signifies compliance with the Fish and Wildlife Coordintaion Act. A Final Coordination Act Report (CAR) will be provided to NED after FWS review of the bioassay/bioaccumulation testing, an "interim" CAR is included in this document.

9. Land and Water Conservation Fund Act of 1965, as amended, 16 U.S.C. 4601-4 et seq

Compliance: Public notice of the availability of this report to the National Park Service (NPS) and the Office of Statewide Planning relative to the Federal and State comprehensive outdoor recreation plans signifies compliance with this Act.

10. Marine Protection, Research, and Sanctuaries Act of 1972, as amended, 33 U.S.C. 1401 et seq.

Compliance: Circulation of this report for public review, including an evaluation and findings concerning the transportation and disposal of dredged material in ocean waters pursuant to Section 102 and 103 of this Act, will occur after the bioassay/bioaccumulation testing has occurred. Compliance will be completed prior to project implementation.

11. National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470 et seq.

Compliance: Coordination with the State Historic Preservation Office determined that no historic or archaeological resources would be affected by the proposed project.

12. National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321 et seq.

Compliance: Completion of this report and finding of No Significant Impact signifies compliance with NEPA.

13. Rivers and Harbors Act of 1899, as amended, 33 U.S.C. 401 et seq.

Compliance: No requirements for Corps projects or programs authorized by Congress.

14. Watershed Protection and Flood Prevention Act, as amended, 16 U.S.C. 1001 et seq.

Compliance: No requirements for Corps' activities.

15. Wild and Scenic Rivers Act, as amended, 16 U.S.C. 1271 et seq.

Compliance: Not Applicable; project is located within the marine environment.

Executive Orders

1. Executive Order 11988, Floodplain Management, 24 May 1977 amended by Executive Order 12148, 20 July 1979.

Compliance: Not Applicable; project is not located within a floodplain.

2. Executive Order 11990, Protection of Wetlands, 24 May 1977.

Compliance: Not Applicable; project does not involve nor impact wetlands.

3. Executive Order 12114, Environmental Effects Abroad of Major Federal Actions, 4 January 1979.

Compliance: Not Applicable; project is located within the United States.

Executive Memorandum

1. Analysis of Impacts on Prime or Unique Agricultural Lands in implementing NEPA, 11 August 1980.

Compliance: Not Applicable; project does not involve nor impact agricultural lands.

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K. Authorizing Legislation of Projects in Boston Harbor, Massachusetts

Acts	Work Authorized	Documents and reports
Mar. 2, 1825	Preservation of islands by seawalls.	
June 14, 1880	Weir River (Nantasket Beach Channel) 9 1/2 feet deep, 100 feet wide to Steamboat Wharf at Nantasket.	
Sept. 19, 1890	Weir River (Nantasket Beach Channel) 9 1/2 feet deep, 150 feet wide to Steamboat Wharf at Nantasket.	
July 25, 1892	Weir River (Nantasket Beach Channel) from mouth of Weir River to Steamboat Wharf at Nantasket Beach 12 feet deep, 150 feet wide.	
Aug. 5, 1886	Fort Point Channel	H. Ex. Doc. 206, 48th Cong. 2nd sess. Annual Rept. 1885 p. 513
	Channel 15 feet deep from Long Island to Nixes Mate Shoal (Nixes Mate Nubble Channel)	Annual Report, 1887, page 517
July 13, 1892	Channel 27 feet deep from Nantasket Roads to President Roads	Annual Report 1893, page 766
Mar. 3, 1899	For 30 foot channel from sea to President Roads through Broad Sound by less direct route than 30 and 40 foot channels	H.Doc. 133, 55th 2nd sess.Annual Report 1808, page 886
June 13, 1902	For 35 foot channel from sea to Boston Naval Shipyard, Chelsea and Charles River Bridges	H.Doc. 119, 56th Cong. 2nd sess.Annual Report 1901, page 1096
	Elimination from project of removal of Finns Ledge at outer entrance	Authorized by Chief of Engineers Mar. 11,1913

Aug. 8, 1917	Depth of 40 feet (45 feet in) rock) in Broad Sound Channel	H. Doc. 931, 63d Cong. 2nd sess.
Aug. 30, 1935	Present project dimesions of channel from President Roads to Commonwealth Pier No. 1, East Boston and anchorage area north side of President Roads	H. Doc. 244, 72d Cong. 1st sess.
Do....	Present project dimensions at that part of approach channel to U.S. Navy drydock No. 3 at South Boston between Main Ship and U.S. harbor line	Rivers and Harbors Committee Doc. 29, 71th Cong. 1st sess.
Aug. 26, 1937	Chelsea River Channel, 30 feet deep	Rivers and Harbors Committee Doc. 24, 75th Cong. 1st sess.
Oct. 17, 1940	Reserved Channel 30 feet deep	H.Doc. 225, 76th Cong. 1st sess.
Sept. 7, 1910	Abandons seaplane channel authorized in 1940 River and Harbor Act (H. Doc. 262, 76th Cong., 1st sess.)	Public Law 420, 78th Cong.
Mar. 2, 1945	Extension of 40 foot channel	H.Doc. 733, 79th Cong. 2nd sess.
July 24, 1946	Extension of President Roads Anchorage	H.Doc 244, 80th Cong. 1st sess.
July 3, 1958	Reserved Channel 35 feet deep, 430 feet wide, extending 1 mile from 40 foot Main Ship Channel to D Street	H.Doc. 349, 84th Cong.
Oct. 23, 1962	Chelsea River Channel and Maneuvering Basin 35 feet deep	H.Doc. 350, 87th Cong. 2nd sess.

APPENDIX I

SEDIMENT ANALYSIS

BOSTON HARBOR SEDIMENT SAMPLES (MARCH - APRIL 1986)

Location	Physical Description	% Fines	Oil/Grease (ppm)	Heavy Metals I	II	III		PCBs (ppb)
Mystic River:								
A	Organic Clay	90	4300 (II)	3	3	3	(Pb,As,V)	
B	Organic Clay	87	4400-5300(II)	1	4	4	(Pb,Zn,As,V)	3000 (III)
C	Lean Clay	95	53 (I)	9	0	0		
D	Clayey Sand	33	1000 (II)	8	1	0		
Chelsea River:								
A	Organic Clay	68	2200 (II)	5	4	0		
B	Organic Clay	65	1200 (I)	8	1	0		
C	Clayey Sand	14	1400 (I)	6	3	0		
D	Organic Clay	75	3300 (II)	5	3	1	(Pb)	
E	Organic Clay	60	4100 (II)	6	3	0		
F	Organic Clay	40	1000 (I)	6	3	0		240 (I)
G	Organic Clay/ Clayey Sand	42	2100 (II)	5	3	1	(Pb)	
H	Organic Clay	50	1300 (I)	7	2	0		
Inner Confluence:								
A	Clayey Sand	18	1000 (I)	7	2	0		
B	Clayey Sand	45	830 (I)	6	3	0		170 (I)
C	Organic Clay	77	1500 (I)	5	3	1	(Pb)	
Reserved Channel:								
A	Organic Clay/ Lean Clay	90/100	6300 (II)	4	4	1	(Pb)	
B	Organic Clay/ Lean Clay	62/96	590 (I)	7	2	0		770 (II)
C	Organic Clay	77	710 (I)	7	2	0		
D	Organic Clay	95	3200 (II)	7	2	0		
Main Ship Channel:								
E	Organic Clay	88	1400 (I)	7	2	0		
F	Organic Silt	85	1300 (I)	7	2	0		
North Broad Sound Channel (1978):								
GE-8	Gravel	0.6	--					
GE-9	Sandy Gravel	1.8	--					
GE-10	Sandy Gravel	5.0	1730 (I)	9	0	0		
GE-11	Gravelly Sand	2.7	--					

I Category One - State of Massachusetts Classification of Dredge or Fill Material
II Category Two - State of Massachusetts Classification of Dredge or Fill Material
III Category Three - State of Massachusetts Classification of Dredge or Fill Material

BOTTOM SEDIMENT SAMPLE TEST RESULTS

ACS NEEDED-6 (FEEDER)

PROJECT NO.-ICC (-7)	PROJECT TITLE ICC 53-82	YEAR ICC 53-58	STATE ICC 57-81	TIDAL SYS ICC 82-86	COMMERC ICC 87-88
86AAI30	Boston Harbor - Reserved Channel	1986	MA	ME	C/R

ITM	#	01	#	02	#	03	#	04	#	05	ITM
LAB SEQ/SL NO.	01	100-437-6		100-437-7		0399		100-437-26		100-437-27	01
LAB/STATION NO.	02	A		A		A		B		B	02
SAMPLE NO.	03	T-1		T-1		T-1		T-3		T-3	03
SAMPLE DEPTH (FT)	04	0.0-0.6		0.6-0.75		surface		0.0-0.67		0.67-0.83	04
LATITUDE	05										05
LONGITUDE	06										06
CO-ORD LOC-NORTH	07	489,530						489,650			07
CO-ORD LOC-EAST	08	725, 900						728,110			08
SOUNDING	11	36						36			11
REDUCED SOUNDING-MLW	12										12
DATE - HOUR	13	4/4/86						3/31/86			13
WEATHER	14										14
SEA STATE	15										15
SECCHI DISC-BLACK	16										16
SECCHI DISC-WHITE	17										17
VISUAL CLASSIFICATION BY LABORATORY	20	Black		Gray				Black		Gray	20
	21	Organic		Lean				Sandy		Lean	21
	22	Clay		Clay				Organic		Clay	22
	23	(OH)		(CL)				Clay		(CL)	23
	24							(OH)			24
	25										25
	26										26
	27										27
	28										28
	29										29
SOIL CLASS/DOMIN	32	OH		CL				OH		CL	32
SOIL CLASS/SUB-DOMIN	33										33
GRAIN SIZE CURVE-RED	34	0.0060		0.0028				0.0130		0.0025	34
GRAIN SIZE CURVE-BL	35	0.0130		0.0070				0.0000		0.0010	35
GRAIN SIZE CURVE-GR	36	LE 0.0015		LE 0.0015				0.0018		0.0015	36
GR SIZE CURVE-% FINE	38	93		100				82		96	38
NORMAL/BIMODAL	39	N		N				N		N	39
LIQUID LIMIT	40	122		48				76		43	40
PLASTIC LIMIT	41	42		24				31		21	41
PLASTIC INDEX	42	80		24				46		24	42
SPEC GRAV SOLIDS	47	2.58		2.74				2.60		2.76	47
WET UNIT WGT (PCF)	48	81.2						91.6			48
DRY UNIT WGT (PCF)	49	37.7						46.8			49
PERCENT SOLIDS	50					54.9					50
SEDIMENT PH	51										51
SED RED POT (AV)	52	R1 132.0		R1 41.8				R1 120.0	R1	39.1	52
% VOL SOLIDS- EPA	57					6.60					57
% VOL SOLIDS- MED	58					3.98					58
% TOT VOL SOL-EPA	59										59
PPM CHEM OXIGEN DMND	60					79,100					60
PPM TOT KJDL NIT	61										61
PPM OIL & GREASE	62				R2	6,300					62
PPM MERCURY	63				R2	1.68					63
PPM LEAD	64				R3	221					64
PPM ZINC	65				R2	264					65
PPM ARSENIC	70					8.8					70
PPM BARIUM	71					810					71
PPM CADMIUM	72				LE	3					72
PPM CHROMIUM	73				R2	186					73
PPM COPPER	74					151					74
PPM BERYLLIUM	75				LE	6					75
PPM NICKEL	76				R2	58					76
PPM COBALT	77				LE	10					77
PPM SILVER	78					7					78
PPM MANGANESE	79					280					79
PPM VANADIUM	80				R2	200					80
% CARBON (ORGANIC)	85										85
% CARBON (INORGANIC)	86										86
% CARBON (TOTAL)	87					5.19					87
% NITROGEN	88					0.80					88
% NITROGEN	89					0.34					89
PPM METHANE	90										90
PPB DDT	91										91
PPB PCB/PCB #1PM	92										92
PERCENT 4 (TBS)	93										93
RADIOACTIVITY(PCI/GM/DRY)	94										94

REMARKS

R1 Σ Natural Water
R2 Class IV - Mass Criteria
R3 Class III - Mass Criteria
R4

a- LEGEND:
LI- LIMIT OF INSTRUMENT
NP- NON-PLASTIC
LT- LESS THAN
GT- GREATER THAN

NED FORM 881

BOTTOM SEDIMENT SAMPLE TEST RESULTS

NCS MCDEC-8 (FREEZER)

PROJECT NO. (CC 1-7)	PROJECT TITLE (CC 13-52)					YEAR (CC 53-58)	STATE (CC 57-61)	TIDAL SYS (CC 62-66)	COMPREC (CC 67-68)
86AA130	Boston Harbor - Reserved Channel 86					1986	MA	ME	C/R
ITM	• 06		• 07		• 08	• 09	• 10	ITM
LAB SER./BL NO.	01	0170		00-437-2X		00-437-23	00-437-24	01
EXPLORATION NO.	02	B		C		D	E	02
COMPOSITE NO.	03	1, 2, 4		1		1	1	03
SAMPLE DEPTH (FT)	04	0.0-0.95		surface		surface	surface	surface	04
LATITUDE	05								05
LONGITUDE	06								06
CG-ORD LOC-NORTH	07			489,530		490,280	489,940	487,750	07
CG-ORD LOC-EAST	08			730,310		729,780	732,180	737,120	08
SOUNDING	11			37		35	35	37	11
REDUCED SOUNDING-MLW	12								12
DATE - HOUR	13			4/4/86		4/4/86	4/3/86	4/3/86	13
WETHER	14								14
SEA STATE	15								15
SEDIM. DISC-BLACK	16								16
SEDIM. DISC-WHITE	17								17
VISUAL CLASSIFICATION BY LABORATORY	20			Light Olive Gray Organic Clay (Oil) with Sand		Black Organic Clay (Oil)	Black Organic Clay (OH)	Black Organic Silt (OH) with Sand	20
	21								21
	22								22
	23								23
	24								24
	25								25
	26								26
	27								27
	28								28
	29								29
SOIL CLASS/COMIN	32			OH		OH	OH	OH	32
SOIL CLASS/SUB-COMIN	33								33
GRAIN SIZE CURVE-MED	34			0.0150		0.0120	0.0150	0.0080	34
GRAIN SIZE CURVE-01	35			0.0300		0.0270	0.0370	0.0400	35
GRAIN SIZE CURVE-03	36			0.0060		0.0020	0.0100	0.0020	36
GR SIZE CURVE-% FINE	38			77		95	88	85	38
NORMAL/BIMODAL	39			B		N	N	B	39
LIQUID LIMIT	40			73		132	105	92	40
PLASTIC LIMIT	41			28		44	39	40	41
PLASTIC INDEX	42			45		88	67	52	42
SPEC GRAV SOLIDS	47			2.65		2.58	2.63	2.52	47
WET UNIT WGT (PCF)	48								48
DRY UNIT WGT (PCF)	49								49
PERCENT SOLIDS	50	56.2		46.7		29.6	33.9	40.7	50
SEDIMENT PH	51	6.8		6.7		6.9	6.7	6.8	51
SED ACX POT (MV)	52								52
% VOL SOLIDS- EPA	57	5.85		6.26		11.35	9.92	18.34	57
% VOL SOLIDS- MED	58	3.46		4.72	RZ	9.28	RZ 8.23	RZ 6.93	58
% TOT VOL SOL-EPA	59								59
PPM CHEM OXIGEN DMND	60	54,900		60,400		84,500	83,800	136,000	60
PPM TOT FUEL HYD	61								61
PPM OIL & GREASE	62	490		710	RZ	3700	1400	1300	62
PPM MERCURY	63	RZ 0.55	RZ	1.34	RZ	0.41	0.66	0.48	63
PPM LEAD	64	86	RZ	105	RZ	109	RZ 122	RZ 101	64
PPM ZINC	65	178		137		136	151	128	65
PPM ARSENIC	70	5.4		6.9		7.2	5.1	5.3	70
PPM BARIUM	71	1200		680		720	840	780	71
PPM CHROMIUM	72	LT 6	LT	3	LT	3	LT 4	LT 4	72
PPM CHROMIUM	73	93		82	RZ	109	RZ 121	RZ 101	73
PPM COPPER	74	73		100		67	78	86	74
PPM BERYLLIUM	75	LT 6	LT	6	LT	6	LT 6	LT 6	75
PPM NICKEL	76	RZ 56		67		67	74	60	76
PPM COBALT	77	LT 10	LT	10	LT	10	LT 10	LT 10	77
PPM SILVER	78	LT 8	LT	7	LT	8	LT 8	LT 8	78
PPM MANGANESE	79	670		790		1190	770	770	79
PPM VANADIUM	80	LT 700	LT	820	LT	690	LT 710	LT 710	80
% CARBON (ORGANIC)	85								85
% CARBON (CARBONATE)	86								86
% CARBON (TOTAL)	87	1.38		2.23		4.30		3.47	87
% HYDROGEN	88	0.45		0.68		0.81		0.65	88
% NITROGEN	89	0.13		0.19		0.49		0.38	89
PPM BENZENE	90								90
PPB PCB	91								91
PPB PYCHL BIPH	92	770							92
CARBON 14 (TRS)	93								93
RADIOACTIVITY(PICOCURIES)	94								94

REMARKS

#1
#2 Class II - Mass Criteria
#3
#4

a- LEGEND:
LI- LIMIT OF INSTANT
NP- NON-PLASTIC
LT- LESS THAN
GT- GREATER THAN

NED FORM, 881 REV 11

NOTE: Site D is located in the proposed Reserved Channel Turning Area
Sites E & F are located in the 35-foot Main Ship Channel

BOTTOM SEDIMENT SAMPLE TEST RESULTS

NOS NEEDED-8 (KEEDER)

PROJECT NO. (CC 1-71): 86AA130
PROJECT TITLE (CC 13-52): Boston Harbor - IC86 Area
Inner Confluence
YEAR (CC 53-56): 1986
STATE (CC 57-61): MA
TIDAL SYS (CC 62-66): ME
COM/ORG (CC 67-69): C/R

ITM	01	02	03	04	05	ITM
GRAB STA. NO.	01	900-437-19	900-437-19	900-437-20		01
CLASSIFICATION NO.	02	A	A	A		02
SAMPLE NO.	03					03
SAMPLE DEPTH (FT)	04	surface	surface	surface		04
LATITUDE	05					05
LONGITUDE	06					06
CO-ORD LOC-NORTH	07	505,860	505,910	501,700		07
CO-ORD LOC-EAST	08	723,690	729,550	723,150		08
SOUND NO	11	34				11
RECEIVED SOUNDING-MLW	12	4/5/86	3/31/86	4/3/86		12
DATE - HOUR	13					13
WEATHER	14					14
SEA STATE	15					15
SEDIM DISP-BLACK	16					16
SEDIM DISP-WHITE	17					17
VISUAL CLASSIFICATION BY LABORATORY	20	Black	Dark	Black		20
	21	Clayey	Olive	Organic		21
	22	Sand	Gray	Clay		22
	23	(SC)	Clayey	with		23
	24	with	Sand	Sandy		24
	25	Gravel	(SC)	(OH)		25
	26					26
	27					27
	28					28
	29					29
SOIL CLASS/COMIN	32	SC	SC	OH		32
SOIL CLASS/SUB-DOMIN	33					33
GRAIN SIZE CURVE-MED	34	0.950	0.0800	0.0075		34
GRAIN SIZE CURVE-01	35	11.0	0.1300	0.075		35
GRAIN SIZE CURVE-05	36	0.120	0.0100	0.0050		36
GR SIZE CURVE-2 FINE	38	18	45	77		38
NORMAL/BIMODAL	39	N	B	B		39
LIQUID LIMIT	40	52	60	100		40
PLASTIC LIMIT	41	26	27	39		41
PLASTIC INDEX	42	26	33	61		42
SPEC GRAV SOLIDS	47	2.65	2.63	2.62		47
WET UNIT WGT (PCF)	48					48
DRY UNIT WGT (PCF)	49					49
PERCENT SOLIDS	50	70.8	50.0	36.6		50
SEDIMENT PH	51	7.0	6.6	7.1		51
EH OR PST (MV)	52					52
% VOL SOLIDS- EPA	57	7.60	5.56	8.44		57
% VOL SOLIDS- NED	58	1.7A	4.18	6.67		58
% TOT VOL SOL-EPA	59					59
PPM CHEM OXIDEM DMND	60	20,600	78,200	81,000		60
PPM TOT KJDL NIT	61					61
PPM OIL & GREASE	62	1000	810	1300		62
PPM MERCURY	63	RZ 0.59	RZ 1.06	RZ 0.74		63
PPM LEAD	64	RZ 182	RZ 138	RZ 273		64
PPM ZINC	65	188	159	RZ 258		65
PPM ARSENIC	70	5.9	4.3	9.4		70
PPM BARIUM	71	600	920	830		71
PPM CADMIUM	72	LT 3	LT 4	LT 3		72
PPM CHROMIUM	73	55	84	RZ 143		73
PPM COPPER	74	51	83	157		74
PPM MERCURY	75	LT 5	LT 7	LT 6		75
PPM NICKEL	76	24	RZ 65	35		76
PPM COBALT	77	LT 10	LT 10	LT 10		77
PPM SILVER	78	LT 6	LT 8	LT 8		78
PPM MANGANESE	79	190	230	270		79
PPM VANADIUM	80	LT 350	LT 710	LT 690		80
% CARBON (ORGANIC)	85					85
% CARBON (CARBONATE)	86					86
% CARBON (TOTAL)	87	1.56	2.51	6.86		87
% HYDROGEN	88	0.76	0.48	0.87		88
% NITROGEN	89	0.10	0.19	0.97		89
PPM BENZENE	90					90
PPB DDT	91					91
PPB PLYCHL BIPH	92		170			92
CARBON 14 (TMS)	93					93
RADIOACTIVITY(NR/HR)	94					94

REMARKS

R1 - #200 Material
R2 Class II - Mass Criteria
R3 Class III - Mass Criteria
R4

a- LEGEND:
LI- LIMIT OF INSTRAT
NP- NON-PLASTIC
LT- LESS THAN
GT- GREATER THAN

NED FORM 7?, 881

BOTTOM SEDIMENT SAMPLE TEST RESULTS

ACS WEEDED-6 (FEEDER)

PROJECT NO.: FCC (-71	PROJECT TITLE: FCC 13-521			YEAR: FCC 53-58	STATE: FCC 57-61	TIDAL SYS: FCC 62-66	COM/REC: FCC 67-69
86AA13D	Mystic River 86			1986	MA	ME	C/R

	ITM		01		02		03		04		05	ITM
LAB SERIAL NO.	01		100-437-16		100-437-4		0367		0368		100-437-17	01
EXPLORATION NO.	02		"A"		"B"		"B"		"B"		"C"	02
SAMP. NO.	03		1		T-2		T-4		T-4		1	03
SAMPLE DEPTH (FT)	04		surface		0.0-0.8		0.0-0.25		1.50-1.75		surface	04
LAT: DDF	05											05
LONG: DDF	06											06
GS-GRD LOC-NORTH	07		906.080		905.270						905.700	07
GS-GRD LOC-EAST	08		718,940		718,390						720,130	08
SOUNDING	11		17		19						16	11
REDUCED SOUNDING-MLW	12											12
DATE - MDAY	13		4/7/86		3/31/86						4/7/86	13
WEATHER	14											14
SEA STATE	15											15
SECCHI DISC-BLACK	16											16
SECCHI DISC-WHITE	17											17
VISUAL CLASSIFICATION BY LABORATORY	20		Black		Black						Dark	20
	21		Organic		Organic						Olive	21
	22		Clay		Clay						Gray	22
	23		(OH)		(OH)						Lean	23
	24										Clay	24
	25										(CL)	25
	26											26
	27											27
	28											28
	29											29
SOIL CLASS/DOMIN	32		OH		OH						CL	32
SOIL CLASS/SUB-DOMIN	33											33
GRAIN SIZE CURVE-MED	34		0.0130		0.0073						0.0022	34
GRAIN SIZE CURVE-81	35		0.0180		0.0230						0.0070	35
GRAIN SIZE CURVE-03	36		0.0055	LT	0.0015	LT				LT	0.0015	36
GR SIZE CURVE-% FINE	38		80		87						93	38
NORMAL/BIMODAL	39		B		B						N	39
LIQUID LIMIT	40		124		92						47	40
PLASTIC LIMIT	41		46		36						23	41
PLASTIC INDEX	42		78		56						24	42
SPEC GRAV SOLIDS	47		2.42		2.60						2.76	47
WET UNIT WGT (PCF)	48				82.2							48
DRY UNIT WGT (PCF)	49				37.3						66.2	49
PERCENT SOLIDS	50		32.7				42.9		46.1			50
SEDIMENT PH	51		6.8				8.9		6.9		7.0	51
SED ACR PST (MV)	52			R1	120							52
% VOL SOLIDS- EPA	57		15.68				11.09		8.92		3.11	57
% VOL SOLIDS- MED	58	R3	13.27			R2	8.46		6.47		1.18	58
% TOT VOL SOL-EPA	59											59
PPM CHEM OXYGEN DMND	60		204.000				134.000		74.600	LT	1000	60
PPM TOT KJDL NIT	61											61
PPM OIL & GREASE	62	R2	4300			R2	3300		4600		53	62
PPM MERCURY	63	R2	0.69			R2	1.35	R2	1.17		0.14	63
PPM LEAD	64	R3	213			R3	362	R3	288		4	64
PPM ZINC	65	R2	242			R3	435	R2	381		102	65
PPM ARSENIC	70	R3	21.7			R2	11.7	R3	28.4		4.8	70
PPM BARIUM	71		840				1200		1200		940	71
PPM CHROMIUM	72	LT	5				4	LT	4	LT	5	72
PPM CHROMIUM	73		77			R2	180	R2	102		22	73
PPM COPPER	74		112			R2	218		124		25	74
PPM DARMIUM	75	LT	6			LT	6	LT	6	LT	6	75
PPM NICKEL	76		29			R2	75	R2	52		12	76
PPM COBALT	77					LT	10	LT	10	LT	10	77
PPM SILVER	78	LT	7			LT	8	LT	8	LT	7	78
PPM MANGANESE	79		280				290		400		470	79
PPM VANADIUM	80	LT	660			LT	710	LT	700	LT	610	80
% CARBON (ORGANIC)	85											85
% CARBON (CARBONATE)	86											86
% CARBON (TOTAL)	87		8.21				5.71		3.41		0.27	87
% NITROGEN	88		0.91				0.91		0.38		0.21	88
% NITROGEN	89		0.36				0.31		0.18	LT	0.1	89
PPM BENZENE	90											90
PPM SDT	91											91
PPB PLYCHL BIPH	92											92
CARBON 14 (YRS)	93					R3	1,000					93
RADIOACTIVITY(MR/HR)	94											94

REMARKS

R1 % Natural Water Content
R2 Class II - Mass Criteria
R3 Class III - Mass Criteria
R4

a- LEGEND:
LI- LIMIT OF INSTRUMENT
NP- NON-PLASTIC
LT- LESS THAN
GT- GREATER THAN

NED FORM 881 REV 77

BOTTOM SEDIMENT SAMPLE TEST RESULTS

RCS NEEDED-6 (FEEDER)

PROJECT NO. (CC 1-7)	PROJECT TITLE (CC 13-52)	YEAR (CC 53-56)	STATE (CC 57-61)	TIDAL SYS (CC 62-66)	COM/REC (CC 67-68)
86AA130	Mystic River 86	1986	MA	ME	C/R

	ITM	06	07	08	09	10	ITM
LAB SERIAL NO.	01	100-437-18					01
DUPLICATE SW NO.	02	D					02
SAMPLE NO.	03	1					03
SAMPLE DEPTH (FT)	04	surface					04
LATITUDE	05						05
LONGITUDE	06						06
GRID COORD-NORTH	07	505.250					07
GRID COORD-EAST	08	721.830					08
SOUNDING	11						11
DEPTH MED SOUND(MT-MLW	12						12
DATE - HOUR	13	4/27/86					13
WEATHER	14						14
SEA STATE	15						15
SECCHI DISC-BLACK	16						16
SECCHI DISC-WHITE	17						17
VISUAL CLASSIFICATION BY LABORATORY	20	Dark					20
	21	Olive					21
	22	Gray					22
	23	Clayey					23
	24	Sand					24
	25	(SC)					25
	26	with					26
	27	Gravel					27
	28						28
	29						29
SOIL CLASS-DOMIN	32	SC					32
SOIL CLASS-SUB-DOMIN	33						33
GRAIN SIZE CURVE-MED	34	0.2500					34
GRAIN SIZE CURVE-D1	35	2.50					35
GRAIN SIZE CURVE-D3	36	0.0430					36
GR SIZE CURVE-% FINE	38	33					38
NORMAL/ABNORMAL	39	N					39
LIQUID LIMIT	40	67					40
PLASTIC LIMIT	41	27					41
PLASTIC INDEX	42	40					42
SPEC GRAV SOLIDS	47	2.58					47
WET UNIT WGT (PCF)	48						48
DRY UNIT WGT (PCF)	49						49
PERCENT SOLIDS	50	49.0					50
SEDIMENT PH	51	7.0					51
SED ADX PH (MV)	52						52
% VOL SOLIDS- EPA	57	5.01					57
% VOL SOLIDS- NED	58	5.01					58
% DIF VOL SOL-EPA	59						59
PPM CHEM OXIGEN DMND	60	50.800					60
PPM TOT VOL HYD	61						61
PPM OIL & GREASE	62	1000					62
PPM MERCURY	63	BI 0.53					63
PPM LEAD	64	96					64
PPM ZINC	65	A1					65
PPM ARSENIC	70						70
PPM BARIUM	71	400					71
PPM CADMIUM	72	LT 5					72
PPM CHROMIUM	73	37					73
PPM COPPER	74	70					74
PPM BERYLLIUM	75	LT 6					75
PPM NICKEL	76	LT 23					76
PPM COBALT	77	LT 10					77
PPM SILVER	78	LT 2					78
PPM MANGANESE	79	210					79
PPM VANADIUM	80	LT 480					80
% CARBON (ORGANIC)	85						85
% CARBON (CARBONATE)	86						86
% CARBON (TOTAL)	87	2.18					87
% HYDROGEN	88	0.48					88
% NITROGEN	89	0.16					89
PPM BENZENE	90						90
PPB DDT	91						91
PPB PLTCHL BIPH	92						92
CARBON 14 (TRS)	93						93
RADIONUCLIDE(S)(TNR/MR)	94						94

REMARKS

R1 Class II - Mass Criteria
R2
R3
R4

o- LEGEND:
LI- LIMIT OF INSTRMT
NP- NON-PLASTIC
LT- LESS THAN
GT- GREATER THAN

NED FORM 881 MAR 77

BOTTOM SEDIMENT SAMPLE TEST RESULTS

ACS NEEDED-8 (FEEDER)

PROJECT NO. (CC 1-7)	PROJECT TITLE (CC 13-52)	YEAR (CC 53-56)	STATE (CC 57-61)	TIDAL SYS (CC 62-66)	COM/SEC (CC 67-80)
86AA130	Chelsea River MA	1986	MA	ME	C/R

ITEM		01	02	03	04	05	ITEM
LAB SERIAL NO.	01	100-437-11	100-437-8	100-437-12	100-437-13	100-437-1	01
EXPLORATION NO.	02	A	1	1	D	E	02
SAMPLE NO.	03				1	1-1	03
SAMPLE DEPTH (FT)	04	surface	surface	surface	surface	0.0-0.95	04
LATITUDE	05						05
LONGITUDE	06						06
CO-ORD LOC-NORTH	07	609,690	608,700	606,050	605,380	605,760	07
CO-ORD LOC-EAST	08	730,780	730,300	729,400	728,915	728,710	08
SOUNDING	11						11
REDUCED SOUNDING-MLW	12						12
DATE - YOUR	13	4/1/86	3/31/86	4/1/86	4/1/86	4/1/86	13
WEATHER	14						14
SEA STATE	15						15
SECCHI DISC-BLACK	16						16
SECCHI DISC-WHITE	17						17
VISUAL CLASSIFICATION BY LABORATORY	20						20
	21	Dark	Olive	Black	Black	Black	21
	22	Olive	Gray	Clayey	Organic	Sandy	22
	23	Gray	Sandy	Sand	Clay	Organic	23
	24	Sandy	Organic	(SC)	with	Clay	24
	25	Organic	Clay		Sand	(OH)	25
	26	Clay	(OH)		(OH)	Organic	26
	27	(OH)					27
	28						28
	29						29
SOIL CLASS/DOMIN	32	OH	OH	SC	OH	OH	32
SOIL CLASS/SUB-DOMIN	33						33
GRAIN SIZE CURVE-MED	34	0.0450	0.0450	3.20	0.0150	0.0400	34
GRAIN SIZE CURVE-01	35	0.0900	0.1000	9.00	0.0700	0.1300	35
GRAIN SIZE CURVE-05	36	0.0120	0.0070	0.180	0.0010	0.0100	36
GR SIZE CURVE-% FINE	38	68	65	14	75	60	38
NORMAL/BIMODAL	39	B	N	B	N	B	39
LIQUID LIMIT	40	56	57	24	53	69	40
PLASTIC LIMIT	41	26	27	27	23	30	41
PLASTIC INDEX	42	30	30	47	30	39	42
SPEC GRAV SOLIDS	47	2.67	2.64 R2	2.59	2.67	2.58	47
WET UNIT WGT (PCF)	48					84.8	48
DRY UNIT WGT (PCF)	49					43.5	49
PERCENT SOLIDS	50	56.5	52.1	60.7	46.7		50
SEDIMENT PH	51	7.0	7.0	7.2	7.2		51
SED ROX POT (MV)	52				R1	95.1	52
% VOL SOLIDS- EPA	57	A 13	5.62	3.69	6.81		57
% VOL SOLIDS- MOD	58	3 1A	4.37	2.39	5.52		58
% TOT VOL SOL-EPA	59						59
PPM CHEM OXYGEN DMND	60	A3 500	132,000	35,600	122,000		60
PPM TOT KJDL NIT	61						61
PPM OIL & GREASE	62	R3 2700	1700	1400 R3	3300		62
PPM MERCURY	63	R3 0.61	0.40	0.45 R3	0.53		63
PPM LEAD	64	R3 158	A0	R2 124 R3	262		64
PPM ZINC	65	187	153	132 R3	215		65
PPM ARSENIC	70	5.1	5.9	5.0	7.3		70
PPM BARIUM	71	900	1300	1000	1800		71
PPM CROMIUM	72	BT A	BT 3	LT 4	LT 4		72
PPM CHROMIUM	73	R3 160	R3 118	R3 146	R3 162		73
PPM COPPER	74	71	61	66	89		74
PPM BERILLIUM	75	BT 7	LT 6	LT 7			75
PPM NICKEL	76	R3 66	45	R3 66	LT 26		76
PPM COBALT	77	BT 10	LT 10	LT 10	LT 10		77
PPM SILVER	78	BT B	BT B	BT B	LT B		78
PPM MANGANESE	79	190	180	130	170		79
PPM VANADIUM	80	R3 120	LT 120	LT 120	100		80
% CARBON (ORGANIC)	85						85
% CARBON (CARBONATE)	86						86
% CARBON (TOTAL)	87	2.11	1.00	2.02	2.38		87
% HYDROGEN	88	0.43	0.23	0.40	0.43		88
% NITROGEN	89	0.15	LT 0.1	0.17	0.21		89
PPB BENZENE	90						90
PPB DDT	91						91
PPB PLYCHL BIPH	92	<	240				92
CARBON 14 (YRS)	93						93
RADIOACTIVITY(MR/HR)	94						94

REMARKS

R1 Σ Natural Water Content
R2 - 440 Material
R3 Class II - Mass Criteria
R4 Class III - Mass Criteria

a- LEGEND:
LI- LIMIT OF INSTANT
NP- NON-PLASTIC
LT- LESS THAN
DT- GREATER THAN

NED FORM 881.

BOTTOM SEDIMENT SAMPLE TEST RESULTS

RCS NEDED-6 (FEEDER)

PROJECT NO. (CC 1-7)	PROJECT TITLE (CC 13-52)			YEAR (CC 53-56)	STATE (CC 57-58)	TIDAL SYS (CC 62-66)	COM/REC (CC 67-69)	
86 AA130	Chelsea River 86			1986	MA	ME	C/R	
ITM	06	•	07	•	08	• 09	• 10	ITM
LAB SER. NO.	01	0190	100-437-9		100-437-2	100-437-1	0191	01
REPLICATION NO.	02	2	2		2	2	2	02
SAMPLE NO	03	B1	1		C-1	C-1	C-2	03
SAMPLE DEPTH (FT)	04	surface	surface		0.0-0.30	0.30-0.70	0.0-0.25	04
LATITUDE	05							05
LONGITUDE	06							06
CO-ORD LOC-NORTH	07		504,870		505,150			07
CO-ORD LOC-EAST	08		728,680		726,160			08
SOUNDING	11		38		36			11
REDUCED SOUNDING-MLW	12							12
DATE - HOUR	13							13
WEATHER	14							14
SEA STATE	15							15
SKETCH DISC-BLACK	16							16
SKETCH DISC-WHITE	17							17
VISUAL CLASSIFICATION BY LABORATORY	20		Dark		Black	Dark		20
	21		Olive		Sandy	Gray		21
	22		Gray		Organic	Clayey		22
	23		Clayey		Clay	Sand		23
	24		Sand		(OH)	(SC)		24
	25		(SC)					25
	26							26
	27							27
	28							28
	29							29
SOIL CLASS/DOMIN	32		SC		OH	SC		32
SOIL CLASS/SUB-DOMIN	33							33
GRAIN SIZE CURVE-MED	34		0.1500		0.0120	0.0900		34
GRAIN SIZE CURVE-90	35		1.000		0.1000	0.1500		35
GRAIN SIZE CURVE-95	36		0.0250		0.0075	0.0350		36
GR SIZE CURVE-% FINE	38		40		68	42		38
NORMAL/BIMODAL	39		N		N	N		39
LIQUID LIMIT	40		28		86	30		40
PLASTIC LIMIT	41		18		39	26		41
PLASTIC INDEX	42		10		47	4		42
SPEC GRAV SOLIDS	47		2.63		2.43	2.38		47
WET UNIT WGT (PCF)	48				89.7			48
DRY UNIT WGT (PCF)	49				51.6			49
PERCENT SOLIDS	50	50.4	63.9				45.8	50
SEDIMENT PH	51	7.2	7.2				7.3	51
EH ADJ POT (mV)	52			B1	170.0	B1 49.0		52
% VOL SOLIDS- EPA	57	4.93	4.67				7.79	57
% VOL SOLIDS- MED	58	5.59	3.49				6.29	58
% TOT VOL SOL-EPA	59							59
PPM CHEM OXYGEN DMND	60	160,800	68,700				102,000	60
PPM TOT KJDL NIT	61							61
PPM OIL & GREASE	62 B2	4100	1000				5500	62
PPM MERCURY	63 B2	1.16	R2 0.81			R2	1.14	63
PPM LEAD	64 B2	178	R2 125			R2	283	64
PPM ZINC	65	164	145			R2	276	65
PPM ARSENIC	70	7.7	8.0				7.1	70
PPM BARIUM	71	1400	850				1400	71
PPM CADMIUM	72 LT	4	LT 4			LT	3	72
PPM CHROMIUM	73 B2	149	88			R2	183	73
PPM COPPER	74	87	72				139	74
PPM BERYLLIUM	75 LT	7	LT 6			LT	6	75
PPM NICKEL	76 LT	28	R2 36				37	76
PPM COBALT	77 LT	10	LT 10			LT	10	77
PPM SILVER	78 LT	8	LT 8			LT	8	78
PPM MANGANESE	79	160	210				200	79
PPM VANADIUM	80 LT	210	LT 210			LT	210	80
% CARBON (ORGANIC)	85							85
% CARBON (CARBONATE)	86							86
% CARBON (TOTAL)	87	2.75	2.45					87
% NITROGEN	88	0.42	0.37					88
% HYDROGEN	89	0.20	0.13					89
PPM BENZENE	90							90
PPB DDT	91							91
PPB TOTCHL B/PM	92		260					92
CARBON 14 (YRS)	93							93
RADIOACTIVITY (MR/HR)	94							94

REMARKS

R1 Σ Natural Water Content
R2 Class II - MASS Criteria
R3 Class III - Mass Criteria
R4

o- LEGEND:
LI- LIMIT OF INSTANT
NP- NON-PLASTIC
LT- LESS THAN
GT- GREATER THAN

NED FORM 681

BOTTOM SEDIMENT SAMPLE TEST RESULTS

RCS NEEDED-6 (FEEDER)

PROJECT NO. (CC 1-7)	PROJECT TITLE (CC 13-52)	YEAR (CC 53-56)	STATE (CC 57-81)	TIDAL 373 (CC 82-86)	COMPREC (CC 87-89)
86AA130	Chelsea River BA	1986	MA	MT	R/C

ITM	•	11	•	12	•	13	•	14	•	15	ITM
01		0192		100-437-13							01
02		G		B							02
03		T-2		1							03
04		0.65-0.70		surface							04
05											05
06											06
07				905 330							07
08				724 450							08
11				35							11
12											12
13											13
14											14
15											15
16											16
17											17
20				Dark							20
21				Olive							21
22				Gray							22
23				Sandy							23
24				Organic							24
25				Clay							25
26				(OH)							26
27											27
28											28
29											29
30				OH							30
33											33
34				0.0750							34
35				0.1300							35
36				0.0150							36
38				50							38
39				18							39
40				74							40
41				24							41
42				50							42
47				2.65							47
48											48
49											49
50		22.7		47.6							50
51		7.3		7.6							51
52											52
57		2.63		5.79							57
58		1.90		3.67							58
59											59
60		13,400		41,300							60
61											61
62	B1	2100		1300							62
63		0.44	R1	0.88							63
64		93	R1	122							64
65		148		110							65
70		5.8		8.1							70
71		780		730							71
72	LT	4	LT	3							72
73	LT	236		69							73
74		37		56							74
75	LT	6	LT	6							75
76		28		26							76
77	LT	10	LT	10							77
78	LT	8	LT	7							78
79		330		810							79
80	LT	210	LT	840							80
85											85
86											86
87		1.72		4.32							87
88		0.32		0.42							88
89		0.12		0.17							89
90											90
91											91
92											92
93											93
94											94

VISUAL CLASSIFICATION BY LABORATORY

REMARKS

R1 Class II - Mass Criteria
R2 Class III - Mass Criteria
R3
R4

o- LEGEND:
LT- LIMIT OF INSTRMT
NP- NON-PLASTIC
LT- LESS THAN
GT- GREATER THAN

NED FORM 881

Results of tests performed on: (1) the standard elutriate prepared from one part sediment taken at the sampling location with four parts water from the sampling location and (2) water from the sampling location are as follows:

	Dredge Site Water "B"	Standard Elutriate Designation and Sediment Depth Used in Preparation Location "B" (0.0 - 1.0 ft) R1	R2	R3	Water Quality Criteria
Manganese (Mn), ppb	<10	<10	<10	<10	100
Nitrate/Nitrite Nitrogen(N), ppm	<0.02	<0.03	<0.03	<0.03	10
Cobalt (Co), ppb	<1.0	<1.0	<1.0	<1.0	-
Sulfate (SO_4), ppm	2340	2390	1880	2170	-
Oil & Grease, ppm	<1	13	2	8	-
Phosphorus					
ortho, ppm	0.05	0.36	0.59	0.34	0.1
total, ppm	0.05	0.46	0.72	0.43	0.1
Mercury (Hg), ppb	1.8	1.0	1.4	0.7	2.1
Lead (Pb), ppb	4.1	6.9	7.1	9.6	140
Zinc (Zn), ppb	<2	<2	<2	<2	170
Arsenic (As), ppb	<2.0	14.6	17.4	12.9	69
Cadmium (Cd), ppb		<0.1	0.4	<0.1	43
Chromium (Cr), ppb	3.3	1.2	4.3	4.2	1100
Copper (Cu), ppb	<1	<1	<1	<1	2.9
Nickel (Ni), ppb	<4.5	<4.5	<4.5	<4.5	140
Silver (Ag), ppb	<0.5	1.8	1.6	<0.5	2.3
Vanadium (V), ppb	<5	<5	<5	<5	
Total PCB, ppb	<0.03	3.30	0.24	3.10	0.03
Total DDT, ppb	<0.02	<0.02	<0.02	<0.02	0.13
Barium (Ba), ppb	140	80	82	99	50,000
Beryllium (Be), ppb	<0.2	<0.2	<0.2	<0.2	-

ELUTRIATE TESTING - Chelsea River, Mass 1986

Results of tests performed on: (1) the standard elutriate prepared from one part sediment taken from various sampling locations with four parts water from each sampling location and (2) water from each sampling location are as follows:

	Dredge Site Water "B"	Standard Elutriate Designation and Sediment Depth Used in Preparation Location "B" (surface) R1	R2	R3	Dredge Site Water "F"	Standard Elutriate Designation and Sediment Depth Used in Preparation Location "F" (surface) R1	R2	R3
Manganese (Mn), ppb	<10	<10	<10	<10	<10	<10	<10	<10
Nitrate/Nitrite Nitrogen(N), ppm	<0.05	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cobalt (Co), ppb	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sulfate (SO_4), ppm	2140	2340	2140	2250	2090	1918	1830	2030
Oil & Grease, ppm	<1.0	<1.0	<1.0	<1.0	<1.0	7.0	1.0	11.0
Phosphorus								
ortho, ppm	0.07	0.22	0.10	0.08	0.06	0.04	0.03	0.03
total, ppm	0.07	0.30	0.18	0.14	0.06	0.11	0.11	0.09
Mercury (Hg), ppb	0.8	1.2	0.7	0.8	1.5	1.6	1.1	1.0
Lead (Pb), ppb	7.8	14.5	3.1	1.8	9.1	2.5	4.4	3.2
Zinc (Zn), ppb	<2	<?	<2	<2	4	<2	<2	<2
Arsenic (As), ppb	<2.0	4.8	2.3	2.0	<2.0	2.2	<2.0	4.7
Cadmium (Cd), ppb	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	1.1	<0.1
Chromium (Cr), ppb	7.7	3.5	2.1	1.5	<1.0	1.5	1.4	<1.0
Copper (Cu), ppb	1	<1	<1	<1	1	<1	<1	2
Nickel (Ni), ppb	<4.5	<4.5	<4.5	<4.5	8.8	<4.5	<4.5	<4.5
Silver (Ag), ppb	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Vanadium (V), ppb	<5	<5	<5	<5	<5	<5	<5	<5
Total PCB, ppb	<0.03	<0.03	<0.03	0.15	<0.03	<0.03	<0.03	<0.03
Total DDT, ppb	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0:02
Barium (Ba), ppb	108	152	142	153	125	130	126	138
Beryllium (Be), ppb	? ?							

Results of tests performed on: (1) the standard elutriate prepared from one part sediment taken from various sampling locations with four parts water from each sampling location and (2) water from each sampling location are as follows:

	Reserved Channel	Standard Elutriate Designation and Sediment Depth Used in Preparation Reserved Channel "B" (0.0 - 1.0 ft)			Inner Confluence	Standard Elutriate Designation and Sediment Depth Used in Preparation Inner Confluence "B" (aurface)		
	Dredge Site Water "B"	R1	R2	R3	Dredge Site Water "B"	R1	R2	R3
Manganese (Mn), ppb	<10	<10	<10	<10	<10	<10	<10	<10
Nitrate/Nitrite Nitrogen(N), ppm	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cobalt (Co), ppb	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sulfate (SO_4), ppm	2540	2090	2190	2180	2390	1960	2340	2060
Oil & Grease, ppm	<1.0	4	<1.0		<1.0	6	<1.0	<1.0
Phosphorus								
ortho, ppm	0.02	0.94	0.86	0.56	0.06	0.03	0.03	0.05
total, ppm	0.02	1.63	1.33	0.78	0.06	0.03	0.12	0.13
Mercury (Hg), ppb	0.9	0.5	0.5	1.0	1.5	1.2	0.8	<0.5
Lead (Pb), ppb	5.5	<1.5	1.9	2.8	5.6	2.4	2.2	2.7
Zinc (Zn), ppb	<2	<2	<2	<2	<2	9	<2	
Arsenic (As), ppb	<2.0	14.7	10.5	5.7	<2.0	2.7	2.6	<2.0
Cadmium (Cd), ppb	<0.1	<0.1	<0.1	<0.1	48	<0.1	0.1	<0.1
Chromium (Cr), ppb	1.2	3.6	2.4	1.8	1.0	<1.0	<1.0	1.5
Copper (Cu), ppb	1	3	<1	1	<1	<1	<1	<1
Nickel (Ni), ppb	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5
Silver (Ag), ppb	<0.5	<0.5	1.7	1.8	<0.5	<0.5	1.2	0.6
Vanadium (V), ppb	<5	<5	<5	<5	<5	<5	<5	<5
Total PCB, ppb	<0.03	0.19	0.09	0.12	<0.03	0.12	<0.03	<0.03
Total DDT, ppb	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Barium (Ba), ppb	73	179	81	69	27	102	46	35
Beryllium (Be), ppb	<0.2	<0.2	<0.2	0.3	<0.2	0.4	1.6	0.2

BOSTON HARBOR SEDIMENT SAMPLES (MARCH - APRIL 1986)
NEW ENGLAND DIVISION

LOCATION	PHYSICAL DESCRIPTION	% FINES	OIL/GREASE (ppm)	HEAVY METALS I	II	III	PCBs (ppb)
Mystic River:							
A	Organic Clay	90	4300 (II)	3	3	3(Pb,As,V)	
B	Organic Clay	87	4400-5300(II)	1	4	4(Pb,Zn,As,V)	3000 (III)
C	Lean Clay	95	53 (I)	9	0	0	
D	Clayey Sand	33	1000 (II)	8	1	0	

PERMIT APPLICANT DATA - MYSTIC RIVER - 1986

Mystic River:						
A - Permitee	89	1100 (I)	4	2	2(Pb,As)*	LT500
B - Permitee	70	4300 (II)	2	3	3(Pb,Zn,As)*	4300(III)

* Vanadium was not analyzed by the applicant.

Harbor, rivers and channels that have the potential to dispose of dredged material at FADS.

Rockport Harbor and Pigeon Cove

Gloucester Harbor, Annisquam River and Smith Cove

Essex River and Caste Neck River

Ipswich River and Eagle Hill River

Rowley River

Manchester harbor

Beverly Harbor

Danvers Crane , and Porter Rivers

Salem Harbor

Marblehead Harbor

Lynn Harbor

Swampscott Harbor

Winthrop harbor

Saugus/Pines River

Malden River

Mystic River

Boston Harbor and Nantasket Beach Channel (Wier river) including:

- Chelsea River
- Fort Point Channel
- Little Mystic (South) Channel

Boston Inner Harbor

Charles River

President Roads Anchorage

Reserved Channel

Main Ship Channel (Broad Sound, North, South and Narrows Channel)

Nubble Channel

Island End River

Dorchester Bay and Neponset River

Weymouth Fore, Town and Back Rivers

Allerton Harbor

Hingham Harbor

Weir River including Nantasket Channel and Sagamore Cove

Cohasset Harbor

Scituate Harbor

Green Harbor

Duxbury Harbor

Kingston Harbor

Plymouth Harbor and Cordage Channel

APPENDIX II

Biological Report

Introduction

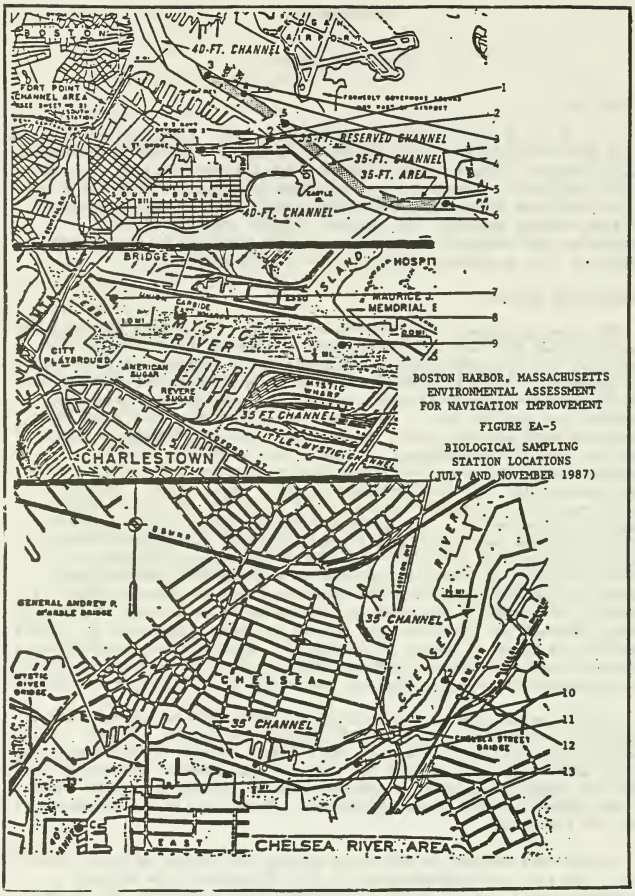
On 1, 2 and 3 July and 18 and 20 November 1986, a biological sampling program was conducted in Boston Harbor by personnel from the Environmental Resource Section, Impact Analysis Branch, New England Division, U.S. Army Corps of Engineers. Assistance was provided by scientist from the U.S. Fish and Wildlife Service and the Massachusetts Coastal Zone Management Office on various cruises. The purpose of this sampling was to characterize the benthic habitat that has the potential to be dredged in association with a proposed improvement dredging project.

Materials and Methods

The areas proposed to be improvement dredged lie within the existing Federal channel that was last maintenance dredged in 1982. The substrate's physical and chemical properties were analyzed in 1985/1986 (see Appendix). Based on previous efforts in Boston Harbor thirteen (13) sampling stations were statistically determined and randomly generated throughout the project area. Four replicate $0.04M^2$ Van Veen grabs were obtained at each station during two seasons (July and November). Each sample was observed undisturbed for grain size category, redox (reduction/oxidation potential discontinuity), present of epifauna or tubes, presence of oils and hydrogren sulphide (H_2S) odors. Onboard, samples were gently screened through a 0.5 mm sieve, stained with Rose Bengal and preserved in a 10% Buffered Formalin and seawater solution. Benthic organisms were identified to species level by competitive bid award to laboratories under contract to the Impact Analysis Branch. Identifications were tabulated and this data along with the National Oceanic Data Center identification codes are found in Appendix II-2. A conversion to number of organisms per square meter by station is found in Tables 1 through 26. Dominance by percent and rank comprising 95% of all organisms are found in Tables 27 through 39. Although few conclusions can be reached from this limited sampling effort, standard diversity indices were calculated for all stations and can be found in Tables 40 through 65.

General water chemistry determinations were made during each day of sampling at various tidal quarters throughout the harbor. These determinations included a temperature (^{o}C) and salinity (0/00) profile at one (1) meter intervals using a YSI Model 33 Salinometer, surface (0.3m) dissolved oxygen (ppm) using a modified Winkler Titration; secchi depth (m) and general weather characterization. These results are summarized in Tables 66 though 80.

Finish were sampled by NED using surface and bottom variable mesh (15 cm to 2 cm) gill nets approximately 2.5 by 70 meters) with paired deployments and a six (6) meter otter trawl where possible. Rough bottom topography restricted trawling to the Mystic River and heavy ship traffic destroyed some of the gill nets. Sampling for finfish was therefore opportunistic for site and duration. The results of the July and November finfish sampling can be found in Appendix II (Tables 81 through 90).



BOSTON HARBOR, MASSACHUSETTS
ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT

FIGURE EA-5

BIOLOGICAL SAMPLING
STATION LOCATIONS
(JULY AND NOVEMBER 1987)

Results

Reserved Channel

Stations 1 and 2 comprised the benthic sampling effort in the Reserved Channel region of the harbor. These stations were not sampled for finfish due to the heavy ship traffic and irregular bottom. The substrate was predominantly organic clay. Water chemistry was only taken in the channel during the ebb tide in July but is can be expected to reflect the Mainship Channel water column parameters.

The benthic sampling program during both July and November 1986 revealed an azoic substrate at Station 1. The absence of macrobenthic organisms may be attributable to sulphide compounds built up in the substrate, poor circulation (oxygen exchange) and/or oil contamination. Visual examination of of the 8 replicates revealed a consistantly strong hydrogen sulphide (H_2S) odor, no redox and a surficial film or surface sheen of oil. Water column parameters taken on an ebb tide in July (Air temperature = 26.7°C) revealed a surface water temperature of 19.0°C and salinity of 25.0 0/00. Surface (0.3m) dissolved oxygen was 7.6 ppm (hyposaturated) and secchi extinction depth was determined as 2.75 meters. Bottom temperature was found to be 13.5°C and salinity was 27.25 0/00.

The July benthic population at Station 2 was determined to be composed of 818.8 individuals per square meter from 9 species. Seven (7) species comprised greater than 95.0% (98.8%) of the individuals. The top five (5) dominant species ranks (based on percentiles) were: the polychaetes Capitella capitata (85.5% of all individuals); Eteone flava (5.3%); Anatides mucosa (1.6%); Spio armata (1.6%); Streblospio benedicti (1.6%); the oligochaetes Oligochaeta (1.6%); Tubificoides spp. (91.6%); the polychaetes Microphthalmus aggregata (0.8%) and Polydora aggregata (0.8%). The November benthic population at Station 2 was determined to be composed of 31.25 individuals per square meter from 3 species. Three (3) species comprised greater than 95.0% (100.0%) of the individuals. The dominant species ranks (based on percentiles) were: The polychaete Polydora ligni (60.0% of all individuals); the bivalve Modiolus modiolus (20.0%) and the amphipod crustacean Ampelisca abdita (20.0%).

This sampling has determined the region to be partially azoic and partially dominated by the polychaete Capitella capitata (700.0/m^2) in July and by the spioned polychaete Polydora ligni (18.75/m^2) in November. The diversity indices depict dissimilar Evenness (J') distribution for each station indicating the extreme dominance Capitella capitata in the July sample and the low number of observations (individuals) and categories (species) in the November sample.

Mainship Channel

Stations 3, 4, 5, and 6 comprised the benthic sampling effort in the Mainship Channel region of the harbor. These stations were sampled for finfish using paired deployments of gill nets for 36 net sampling hours in July and 36 net sampling hours in November.

The substrate was predominately organic silt/clay. Water chemistry was taken through the low, flood, high, and ebb tide quarters in July and through the high and low quarters in November.

The July benthic population at Station 3 was determined to be composed of 3037.5 individuals per square meter from 27 species. Ten (10) species comprised greater than 95.0% (95.3%) of the individuals. The top five (5) dominant species ranks (based on percentiles) were: The polychaetes Polydora aggregata (38.9%); Polydora ligni (24.5%); Capitella capitata (12.8%); Eteone flava (8.8%) and Spio armata (5.3%). The November benthic population at Station 3 was determined to be composed of 6.25 individuals per square meter from 1 species. This species was the polychaete Nereis virens.

The July benthic population at Station 4 was determined to be composed of 6,018.75 individuals per square meter from 28 species. Ten (10) species comprised greater than 95.0% (95.5%) of the individuals. The top five (5) dominant species ranks (based on percentiles) were: The polychaete Polydora ligni (31.0%), Capitella capitata (27.6%) Polydora aggregata (21.9%), Eteone flava (9.7%); and Spio armata (1.3%). The November benthic population at Station 4 was determined to be composed of 18.75 individuals per square meter from 2 species. These species were the decapod crustacean Pagurus acadianus (66.6%) and the obligochaete annelid Tubificidae (33.3%).

The July benthic population at Station 5 was determined to be composed of 6125.0 individuals per square meter from 41 species. Twenty-two (22) species comprised greater than 95.0% (95.1%) of the individuals. The top five (5) dominant species ranks (based on percentiles) were: the oligochaeta Tubificoides sp. (18.8%); the polychaetes Polydora aggregata (11.0%); Spio armata (9.5%); Polydora ligni (8.6%); and Nephtys caeca (4.8%). The November benthic population at Station 5 was determined to be composed of 1,931.4 individuals per square meter from 16 species. Six (6) species comprised greater than 95.0% (98.8%) of the individuals. The top five (5) dominant species ranks (based on percentiles) were: the polychaetes Streblospio benedicti (35.6%); the oligochaetes Tubificoides spp. (28.75%); the polychaetes Polydora ligni (21.7%); Tharyx acutus (5.2%) and Spio sp. (3.2%).

The July benthic population at Station 6 was determined to be composed of 2,775.0 individuals per square meter from 32 species. Twenty-one (21) species comprised greater than 95.0% (97.0%) of the individuals. The top five (5) dominant species ranks (based on percentiles) were: the

polychaetes Nephtys caeca (29.5%); the amphipod crustacean Ampelisca abdita (19.8%); the bivalve mollusc Enis directus (7.7%); the Gastropod mollusc Nassarius trivittatus (6.5%) and the polychaete Polydora ligni (6.1%). The November benthic population at Station 6 was determined to be composed of 7055.7 individuals per square meter from 26 species. Seven (7) species comprised greater than 95.0% (95.1%) of the individuals. The top five (5) dominant species ranks (based on percentiles) were: the amphipod crustacean Ampelisca abdita (42.4%); the polychaete Polydora ligni (18.4%); the gastropod mollusc Nassarius trivittatus (16.2%); and the polychaete Streblospio benedicti (10.4%) and Tharyx acutus (3.9%).

This sampling has determined the inner Mainship Channel (Stations 3 & 4) region to be dominated by a spionid-capitellid assemblage in the July sampling and an occasional transient species in November. The outer Mainship Channel (Stations 5 & 6) was dominated be a diverse assemblage of polychaetes, crustaceans, bivalves and gastropods in dense concentrations in the outer (Station 6) region in both July and November. The station 5 assemblage reflected an intermediate transition from inner Mainship Channel to outer.

In July 1986, Station 3 had 27 species and Station 4 had 28 species with corresponding high densities of individuals. In November 1986, Stations 3 & 4 (Inner Mainship Channel) had one (1) and two (2) species present respectively, with very low densities. In the outer Mainship Channel stations species density was also high in July and lower in November. Station 5 had 41 species in July and 16 species in November with a corresponding 32% decrease in individual densities. Station 6 had 32 species with 2.775 individuals/m^2 in July and 26 species with 7,055.65 organisms/m^2 in November 1986. The contrasting decrease in species (32 to 26) with increasing density (2775 to 7055.65/m^2) can be explained by a large population of amphipod crustaceans (Ampelisca abdita) at the station. Evenness of dominance decreased for each station from July to November with Simpson's probability that two random individuals would not belong to the same species remaining essentially unchanged. The density alterations in species represent the spring larval recruitment into the population and the sum total of predation, competition and physical stresses associated with increased water temperature and stratification (e.g. hypoxia) decreasing densities as reflected in the November samples.

Finfish samples in the Mainship Channel area were obtained during a 72 sampling hour effort on 4 different sampling days (2 in July and 2 in November). The dominant finfish species was winter flounder, Pseudopleuronects americanus in all samples. Sampling at Outer Mainship Channel sites (stations 5 and 6) obtained more species and individuals that Inner Mainship Channel sites (stations 3 and 4) in both seasons.

In addition to winter flounder, the July sampling obtained rainbow smelt Osmerus mordax; lobster Homarus americanus; alewife Alosa pseudoharengus; windowpane flounder Scopthalmus aquosus; Atlantic menhaden Brevoortia tyrannus; and Jonah crab Cancer borealis. The November

sampling revealed the same winter flounder dominance and: rainbow smelt Osmerus mordax; windowpane flounder Scopthalmus aquosus; tomcod Microgadus tomcod; Atlantic mackerel Scomber scombrus; blueback herring Alosa aestivalis; longhorn sculpin Myoxocephalus octodecemspinosus; Jonah crab Cancer borealis and green crabs Carcinus meanas.

Water column parameters were measured for the Main Ship Channel at Station 6 (outer Main Ship Channel) and at the Coast Guard Station (inner Main Ship Channel). The outer Main Ship Channel water column was saturated (105%) with oxygen on the flood tides and nearly saturated (83-96%) at ebb and low tides in July. The surface water temperature averaged 15.98°C (S.D. = 1.4) and bottom temperature averaged 13.8°C (S.D. 0.99) in July. Salinities in July averaged 25.3 0/00 (S.D. = 1.6) for surface and 26.4 0/00 (S.D. = 1.6) for bottom. In November, the water column temperature was 9.25°C at the surface and 8.75°C at the bottom. Salinity was 18.5 0/00 surface and 22.0 0/00 bottom. Secchi disc extinction depth averaged 2.4m (S.D. = 0.6) in July and was 3.3 meters in November.

The inner Main Ship Channel water column averaged 61.1% (S.D. = 9.2) saturated with oxygen for all tide quarters. In November the oxygen level was 67.9% saturated at low tide. Surface water temperature averaged 15.2°C (S.D. = 2.5) and bottom water temperature averaged 13.9°C (S.D. = 1.0). In November surface temperature was 8.8°C and bottom temperature 9.0°C. In July surface salinities averaged 19.1 0/00 (S.D. = 4.1) and bottom salinities averaged 26.7 0/00 (S.D. = 0.5) reflecting the salt wedge. In l'ovember surface water salinity was 20.0 0/00 and bottom salinity was 21.9 0/00. Secchi disc extinction depth averaged 1.7 meters (S.D. = 0.53) and in November the secchi disc extinction level was 8.9 meters.

Mystic River

Stations 7, 8 and 9 comprised the benthic sampling effort in the Mystic River region of the harbor. These stations were sampled for finfish using paired deployments of gill nets for 12 sampling hours in July and 12 sampling hours in November. Five minute otter trawls were taken 9 times in July and 4 times in November.

The substrate was predominately organic clay. Water chemistry was taken through the flood and high tide quarters in July and in November 1986.

During both sampling seasons all 8 Van Veen samples at Station 7 were azoic with no redoz layer, a strong hydrogen sulphide (H_2S) odor and visible oil content. No organisms were present.

The July benthic population at Station 8 was determined to be composed of 393.8 individuals per square meter from 5 species. Two (2) species comprised greater than 95.0% (95.3%) of the individuals. The top five (5) dominant species ranks (based on percentiles) were: the

polychaetes Capitella capitata (90.5%); Polydora aggregata (4.8%); Eteone flava (1.6%); Microphthalmus aberrans (1.6%) and the crustacean Aerodae sp. (1.6%). The November benthic population at Station 8 was determined to be composed of 12.5 individuals per square meter from 2 species. These species were a gastropod mollusc (6.25/m^2) immature and therefore unidentifiable and the decapod crustacean Crangon septemspinosa (6.25/m^2).

The July benthic population at Station 9 was determined to be composed of 437.5 individuals per square meter from 10 species. Eight (8) species comprised greater than 95.0% (97.3%) of the individuals. The top five (5) dominant species ranks (based on percentiles) were: the polychaetes Capitella capitata (38.6%); Polydora ligni (15.7%); Caulleriella sp. (15.7%); Polydora aggregata (12.9%); Eteone flava (5.7%); Nphtys sp. (2.9%). The November benthic population at Station 9 was determined to be composed of 6.25 individuals per square meter from 1 species, Streblospio benedicti (100%).

This sampling has determined the Mystic River region to be dominated by the polychaetes Capitella capitata in July at those stations (8 & 9) that are not azoic. The November benthic population seems to be azoic at all stations with the exception of a random occurance of motile species. The diversity indices reflect the azoic conditions and at Station 9 indicate moderate evenness of distribution of individuals (e.g. Capitellids and Spionids) among species.

Finfish samples using gill nets were obtained in the Mystic River during a 24 sampling hour effort on 2 different sampling days (1 in July and 1 in November). The only finfish species sampled in July and November was the rainbow smelt Osmerus mordax and green crabs Carcinus maenas were also recovered.

Finfish samples using Otter Trawls were taken in the Mystic River 9 times (5 minute tows) in July and 4 times in November. No species were collected in July except for an occasional starfish (Asterias vulgaris). In November winter flounder, Pseudopleuronectes americanus dominated the trawl catches. The pooled sample contained 443 winter flounder (58.2% male) averaging 9.59 (S.D. = 3.51) with an average individual weight of 0.014 kg. The windowpane flounder Scopthalmus aquosus was the next dominant species with a pooled density of 23 averaging 8.87 cm (S.D. = 4.19) and individual weight calculated as 0 018 kg. Fourteen (14) rainbow smelt Osmerus mordax averaged 13.1 cm (S.D. = 3.95); twelve (12) blueback herring Alosa aestivalis averaged 11.2 cm (S.D. = 1.67); seven (7) Atlantic silverside Menidia menidia averaged 11.1 cm (S.D. = 4.20); and two longhorn sculpin Myoxocephalus octodecempinosus averaged 8.3 cm (S.D. = 0.42). Additionally, Crangon septemspinosa were estimated at 5796 individuals weighing 3.62 kg and 72 green crabs Carcinus maenas averaging 4.54 cm (S.D. = 1.12) and weighing approximately 0.026 kg each were recovered.

Water column parameters were measured at Station 8 in the Mystic River at flood to high tide in July and November 1986. Surface dissolved oxygen was only determined in the winter as 73% saturated. Surface water temperature was 18.5°C and bottom temperature was 13.9°C with an indication of stratification at approximately 5-6 meters. Salinity ranged from a surface salinity of 17.0 0/00 to a bottom salinity of 27.0 ppt. In November 1986, surface water temperature was 11.0°C and bottom temperature was 8.75°C. Salinity was 22.0 0/00 at the surface and 22.0 0/00 on the bottom. Secchi disc extinction was 0.96m in July and 3.25m in November.

Chelsea River and Inner Confluence Area

Stations 10, 11, 12 and 13 comprised the benthic sampling effort in the Chelsea River and Inner Confluence region of the harbor. These stations were sampled for finfish using paired deployments of gill nets for 48 sampling hours, 36 in July and 12 sampling hours in November. The substrate was predominantly organic clay when not sand. Water chemistry was taken in the ebb tide in July and flood tide in November.

The July benthic population at Station 10 was determined to be composed of 19,181.25 individuals per square meter from 35 species. Eight (8) species comprised greater than 95.0% (95.2%) of the individuals. The top five (5) dominant species ranks (based on percentiles) were: the polychaetes Polydora ligni (43.4%); Polydora aggregata (24.7%); Capitella capitata (8.2%); Eteone flava (6.1%); and Spio armata (5.6%). This station undergoes a remarkable change in community structure in response to temperal alterations presumably associated with water column fluctuations of dissolved oxygen concentrations, stratification and sulphidic accretion. The November benthic population at Station 10 was determined to be composed of 68.75 individuals per square meter from 1 species; the polychaete Streblospio benedicti.

The July benthic population at Station 11 was determined to be composed of 6756.25 individuals per square meter from 27 species. Ten (10) species comprised greater than 95.0% (95.5%) of the individuals. The top five (5) dominant species ranks (based on percentiles) were: the polychaetes Capitella capitata (32.7%); Eteone flava (13.0%); Polydora aggregata (13.0%); Tubificoides spp. (11.8%); Spio armata (9.1%); and Spio filicornis (8.5%). The November benthic population at Station 11 was determined to be composed of 25.05 individuals per square meter from 4 species. Four (4) species comprised greater than 95.0% (100.0%) of the individuals. These (4) species were equally represented (at 25%) in density: the oligochaetes tubificidea; Pelescolex sp.; the polychaete Capitella capitata and the bivalve mollusc Tellina agilis.

The July benthic population at Station 12 was determined to be composed of 3412.5 individuals per square meter from 13 species. Five (5) species comprised greater than 95.0% (96.6%) of the individuals. The top five (5) dominant species ranks (based on percentiles) were: the polychaetes Capitella capitata (81.0%); Microphthalmus aberrans (4.6%);

streblospio benedicti (4.0%); the oligochaete tubificoides sp. (3.85); and the polychaete Polydora ligni (3.3%). The November benthic population at Station 12 was azoic.

The July benthic population at Station 13 (inner confluence area of the Mystic and Chelsea River) was determined to be composed of 9,781.25 individuals per square meter from 28 species. Eleven (11) species comprised greater than 95.0% (96.0%) of the individuals. The top five (5) dominant species ranks (based on percentiles) were: The polychaetes Polydora aggregata (54.6%); Eteone flava (13.1%); Polydora ligni (12.0%); Spio armata (4.0%) and the oligochaete Tubificoides spp. (2.3%). The November benthic population at Station 13 was determined to be composed of 100.0 individuals per square meter from 3 species. Three (3) species comprised greater than 95.0% (98.8%) of the individuals. Their dominance by species ranks (based on percentiles) were: the oligochaete tubificidae (56.3%); the polychaetes Tharyx acutus (31.25%) and Streblospio benedicti (12.5%).

This sampling has determined the region to be characterized in July by the dense polychaete assemblage dominated by a Polydora-Capitella Eteone species complex. In November a residual population (capitellid and spionid) remains in response to temporal perturbation.. The diversity indices depict similar Evenness (J') distribution for most stations in July with a similar probability of a sampled individual not being from the same species. The November population diversity indices reflect the depauperate sample population.

Gillnet finfish samples in the Chelsea River were obtained during a 48 sampling hour effort on 2 different sampling days (1 in July and 1 in November). The dominant finfish species in July (26 net hours) was rainbow smelt Osmerus mordax, four (4) of which averaged 16.0 cm (S.D. = 1.1). Also present were: an alewife Alosa pseudoharengus (26.5 cm); a menhaden Brevoortia tyrannus (23.0 cm); a spider crab (6.7 cm) and four (4) green crabs Carcinus meanas (6.3 cm). The 12 sample hour gillnet deployment in November did not capture any organisms.

The Chelsea River water column was sampled in the vicinity of Station 12 on the ebb tide in July and flood tide in November 1986. Dissolved oxygen levels (surface = 0.3m) were 93% saturated in July, but not determined in November. Surface water temperature in July was 16.25°C and bottom temperature was 15.0°C. Salinity was 25.5 0/00 at the surface and 26.5 0/00 on the bottom. In November 1986, surface water temperature was 6.5°C and bottom temperature was 7.75°C. Salinity was 22.0 0/00 on the surface and 22.0 0/00 on the bottom. Secchi disc extinction was 1.6 meters in July and 3.4 meters in November 1986.

Table 1. Benthic samples from Boston Harbor (0.04m^2 Van Veen Grab and 0.5mm sieve).

STUDY SITE = BOSTON HARBOR, MA

STATION = 1 SAMPLING DATE = 7-3-86

TAXA	#/m^2	% Total Ni	Rank
	0		

Field Notes: Reserve Channel; silty sediment, 0mm redox layer, strong H_2S odor and oil (visible sheen and odor) present (azoic). (Moon jellyfish, Aurelia aurita present, approximately 7/m^2)

Table 2. Benthic samples from Boston Harbor (0.04m^2 Van Veen Grab and 0.5mm sieve).

STUDY SITE = BOSTON HARBOR, MA

STATION = 2 SAMPLING DATA = 7-3-86

TAXA	#/m^2	% Total Ni	Rank
POLYCHAETA			
Anaitides mucosa	12.5	1.6	3
Eteone flava	43.75	5.3	2
Microphthalmus aberrans	6.25	0.8	4
Polydora aggregata	6.25	0.8	4
Spio armata	12.5	1.6	3
Streblospio benedicti	12.5	1.6	3
Capitella capitata	700.00	85.5	1
OLIGOCHAETA			
Oligochaeta	12.5	1.6	3
Tubificoides spp.	12.5	1.6	3
TOTAL	818.8	100.4	

Field Notes: Turning area at the confluence of the Reserve Channel and the Mainship Channel; silty sediment, 0mm redox layer (Aurelia aurita present).

Table 3. Benthic samples from Boston Harbor ($0.04m^2$ Van Veen Grab and 0.5mm sieve).

STUDY SITE = BOSTON HARBOR, MA

STATION = 3 SAMPLING DATE = 7-2-86

TAXA	$\#/m^2$	% Total Ni	Rank
POLYCHAETA			
Polynoidae sp. (juvenile)	6.25	0.2	
Pholoe minuta	31.25	1.0	
Anaitides mucosa	25.0	0.8	
Anaitides maculata	6.25	0.2	
Eteone flava	268.75	8.8	4
Microphthalmus aberrans	25.0	0.8	
Autolytus cornutus	6.25	0.2	
Nereis virens	43.75	1.4	
Nephtys caeca	6.25	0.2	
Polydora quadrilobata	6.25	0.2	
Polydora ligni	743.75	24.5	2
Polydora aggregata	1181.25	38.9	1
Prionospio (P.) steenstrupi	6.25	0.2	
Spio filicornis	12.5	0.4	
Spio setosa	6.25	0.2	
Spio armata	162.5	5.3	5
Streblospio benedicti	6.25	0.2	
Cirratulidae sp. (fragment)	12.5	0.4	
Caulleriella sp.	6.25	0.2	
Capitella capitata	387.5	12.8	3
OLIGOCHAETA			
Oligochaete	6.25	0.2	
Tubificoides spp.	31.25	1.0	
GASTROPODA			
Nassarius trivittatus	6.25	0.2	
BIVALVIA			
Modiolus modiolus	12.5	0.4	
Hiatella sp. (juvenile)	18.75	0.6	
CRUSTACEA			
Corophium sp. (juvenile)	6.25	0.2	
Amphiporeia virginiana	6.25	0.2	
TOTAL	3037.5	99.7	

Field Notes: Mainship Channel across from Fish Pier; silty sediments, 1mm redox, H_2S odor and polychaete tubes present.

Table 4. Benthic samples from Boston Harbor ($0.04m^2$ Van Veen Grab and 0.5mm sieve).

STUDY SITE = BOSTON HARBOR, MA

STATION = 4 SAMPLING DATE = 7-2-86

TAXA	#/m^2	% Total Ni	Rank
NEMERTINEA			
Nemertinea	6.25	0.1	
POLYCHAETA			
Harmothoe imbricata	12.5	0.2	
Polynoidae sp. (juvenile)	12.5	0.2	
Pholoe minuta	50.0	0.8	
Anaitides mucosa	50.0	0.8	
Anaitides maculata	6.25	0.2	
Anaitides sp. (juvenile)	6.25	0.2	
Eteone flava	581.25	9.7	4
Microphthalmus aberrans	62.5	1.0	
Nereis virens	37.5	0.6	
Nephtys caeca	6.25	0.1	
Polydora caulleryi	6.25	0.1	
Polydora ligni	1868.75	31.0	1
Polydora aggregata	1318.75	21.9	3
Prionospio (P.) steenstrupi	12.5	0.2	
Spio filicornis	37.5	0.6	
Spio armata	81.25	1.3	5
Spiophanes bombyx	6.25	0.1	
Streblospio benedicti	25.0	0.4	
Pherusa plumosa	12.5	0.2	
Capitella capitata	1662.5	27.6	2
Pectinaria granulata	6.25	0.1	
Ampharete arctica	6.25	0.1	
OLIGOCHAETA			
Tubificoides spp.	43.75	0.7	
GASTROPODA			
Nassarius trivittatus	37.5	0.6	
BIVALVIA			
Modiolus modiolus	6.25	0.1	
Hiatella sp. (juvenile)	43.75	0.7	
CRUSTACEA			
Diastylis sculpta	12.5	0.2	
TOTAL	6018.75	99.8	

Field Notes: Mainship Channel between Fish Pier and Reserved Channel; sandy-silt sediment, 0 to 1mm redox layer, H_2S odor trace of oil (visible sheen) and polychaete tubes present.

Table 5. Benthic samples from Boston Harbor ($0.04m^2$ Van Veen Grab and 0.5mm sieve).

STUDY SITE = BOSTON HARBOR, MA

STATION = 5 SAMPLING DATE = 7-3-86

TAXA	#/m^2	% Total Ni	Rank
NEMERTINEA			
Nemertinea	12.5	0.2	
POLYCHAETA			
Harmothoe imbricata	75.0	1.2	
Pholoe minuta	256.25	4.2	
Anaitides mucosa	118.75	1.9	
Eteone flava	275.0	4.5	
Microphthalmus aberrans	287.5	4.7	
Autolytus sp. (Polybostrichus)	6.25	0.1	
Nereis virens	281.25	4.6	
Nephtys caeca	293.75	4.8	5
Schistomeringos caeca	6.25	0.1	
Polydora socialis	12.5	0.2	
Polydora quadrilobata	68.75	1.1	
Polydora ligni	525.0	8.6	4
Polydora aggregata	675.0	11.0	2
Prionospio (P.) steenstrupi	212.5	3.5	
Spio filicornis	181.25	3.0	
Spio cf. limicola	56.25	0.9	
Spio armata	581.25	9.5	3
Streblospio benedicti	137.5	2.2	
Trochochaeta multisetosa	31.25	0.5	
Cirratulidae sp. (fragment)	25.0	0.4	
Caulleriella sp.	250.0	4.1	
Pherusa plumosa	31.25	0.5	
Capitella capitata	100.0	1.6	
Mediomastus californiensis	18.75	0.3	
Pectinaria granulata	18.75	0.3	
Ampharete arctica	6.25	0.1	
Polycirrus sp.	6.25	0.1	
OLIGOCHAETA			
Oligochaeta	12.5	0.2	
Tubificoides spp.	1150.0	18.8	1

TAXA	#/m^2	% Total Ni	Rank
GASTROPODA			
Nassarius trivittatus	56.25	0.9	
BIVALVIA			
Modiolus sp. (juvenile)	125.0	2.0	
Tellina sp. (juvenile)	18.75	0.3	
Mya arenaria	6.25	0.1	
Hiatella arctica	18.75	0.3	
Bivalvia sp. (juvenile)	18.75	0.3	
CRUSTACEA			
Edotea triloba	18.75	0.3	
Ampelisca abdita	87.5	1.4	
Corophium sp. (juvenile)	12.5	0.2	
Unciola irrorata	37.5	0.6	
Photis pollex	12.5	0.2	
TOTAL	6125.0	99.8	

Field Notes: Mainship Channel across from the Reserved Channel; silt/shell over clay, patchy 1mm redox and polychaete tubes present.

Table 6. Benthic samples from Boston Harbor (0.04m^2 Van Veen Grab and 0.5mm sieve).

STUDY SITE = BOSTON HARBOR, MA

STATION = 6 SAMPLING DATE = 7-3-86

TAXA	#/m^2	% Total Ni	Rank
POLYCHAETA			
Pholoe minuta	18.75	0.7	
Anaitides mucosa	31.25	1.1	
Anaitides sp. (juvenile)	6.25	0.2	
Eteone flava	37.5	1.4	
Nereis virens	118.75	4.3	
Nephyts caeca	818.75	29.5	1
Polydora quadrilobata	18.75	0.7	
Polydora ligni	168.75	6.1	5
Polydora aggregata	31.25	1.1	
Prionospio (P.) steenstrupi	56.25	2.0	
Spio filicornis	6.25	0.2	
Spio cf. limicola	62.5	2.3	
Spio armata	18.75	0.7	
Streblospio benedicti	56.25	2.0	
Caulleriella sp.	18.75	0.7	
Capitella capitata	12.5	0.5	
Mediomastus californiensis	6.25	0.2	
Pectinaria granulata	12.5	0.5	
GASTROPODA			
Nassarius trivittatus	181.25	6.5	4
BIVALVIA			
Modiolus sp. (juvenile)	12.5	0.5	
Ensis directus	212.5	7.7	3
Tellina sp. (juvenile)	12.5	0.5	
Mya arenaria	37.5	1.4	
Hiatella sp. (juvenile)	6.25	0.2	
CRUSTACEA			
Diastylis sculpta	81.25	2.9	
Diastylis polita	25.0	0.9	
Ampelisca abdita	550.0	19.8	2
Unciola irrorata	25.0	0.9	
Photis pollex	81.25	2.9	

TAXA	#/m^2	% Total Ni	Rank
Orchomene minuta	6.25	0.2	
Dyopedos monacanthus	37.5	1.4	
Crangon septemspinosa	6.25	0.2	
TOTAL	2775.0	100.2	

Field Notes: Mainship Channel at President Roads anchorage; sand and silt, patchy 1mm redox layer, H_2S odor and some tubes present.

Table 7. Benthic samples from Boston Harbor (0.04m^2 Van Veen Grab and 0.5mm sieve).

STUDY SITE = BOSTON HARBOR, MA

STATION = 7	SAMPLING DATE = 7-2-86		
TAXA	#/m^2	% Total Ni	Rank
	(No organisms recovered)		

Field Notes: Mystic River western station, silty sediment, 0mm redox, strong oil (odor and visible sheen) and strong H_2S odor (azoic).

Table 8. Benthic samples from Boston Harbor (0.04m^2 Van Veen Grab and 0.5mm sieve).

STUDY SITE = BOSTON HARBOR, MA

STATION = 8	SAMPLING DATE = 7-2-86		
TAXA	#/m^2	% Total Ni	Rank
POLYCHAETA			
Eteone flava	6.25	1.6	3
Microphthalmus aberrans	6.25	1.6	3
Polydora aggregata	18.75	4.8	2
Capitella capitata	356.25	90.5	1
CRUSTACEA			
Aoridae sp. (juvenile)	6.25	1.6	3
TOTAL	393.75	100.1	

Field Notes: Mystic River central station; silty sediment, 0mm redox, strong H_2S odor and oil (odor and visible sheen).

Table 9. Benthic samples from Boston Harbor (0.04m^2 Van Veen Grab and 0.5mm sieve).

STUDY SITE = BOSTON HARBOR, MA

STATION = 9 SAMPLING DATE = 7-2-86

TAXA	#/m^2	% Total Ni	Rank
POLYCHAETA			
Eteone flava	25.0	5.7	4
Nephtys sp. (juvenile)	12.5	2.9	5
Polydora quadrilobata	6.25	1.4	
Polydora ligni	68.75	15.7	2
Polydora aggregata	56.25	12.9	3
Spio filicornis	6.25	1.4	
Streblospio benedicti	12.5	2.9	5
Caulleriella sp.	68.75	15.7	2
Capitella capitata	168.75	38.6	1
OLIGOCHAETA			
Tubificoides spp.	12.5	2.9	
TOTAL	437.5	100.1	

Field Notes: Mystic River eastern station; silty sediment, 0mm redox layer, some H_2S and oil (odor and some sheen) present.

Table 10. Benthic samples from Boston Harbor (0.04m^2 Van Veen Grab and 0.5mm sieve).

STUDY SITE = BOSTON HARBOR, MA

STATION = 10 SAMPLING DATE = 7-2-86

TAXA	#/m^2	% Total Ni	Rank
POLYCHAETA			
Pholoe minuta	206.25	1.1	
Anaitides mucosa	25.0	0.1	
Anaitides maculata	6.25	0.03	
Anaitides sp. (juvenile)	12.5	0.07	
Eteone flava	1175.0	6.1	4
Eteone heteropoda	6.25	0.03	
Microphthalmus aberrans	118.75	0.6	
Autolytus cornutus	6.25	0.03	
Nereis virens	31.25	0.2	
Glycera dibranchiata	6.25	0.03	
Polydora socialis	6.25	0.03	
Polydora caulleryi	43.75	0.2	
Polydora quadrilobata	25.0	0.1	
Polydora ligni	8300.0	43.3	1
Polydora aggregata	4743.75	24.7	2
Prionospio (P.) steenstrupi	81.25	0.4	
Spio filicornis	450.0	2.3	
Spio setosa	6.25	0.03	
Spio cf. limicola	6.25	0.03	
Spio armata	1075.0	5.6	5
Streblospio benedicti	493.75	2.6	
Trochochaeta multisetosa	12.5	0.07	
Cirratulidae sp. (fragment)	181.25	0.9	
Caulleriella sp.	43.75	0.2	
Pherusa plumosa	31.25	0.2	
Capitella capitata	1568.75	8.2	3
Mediomastus californiensis	6.25	0.03	
Ampharete arctica	6.25	0.03	
Asabellides oculata	12.5	0.07	
Amphitrite figulus	6.25	0.03	
Sebellisae sp. (juvenile)	6.25	0.03	
OLIGOCHAETA			
Tubificoides spp.	456.25	2.4	

TAXA	#/m^2	% Total Ni	Rank
GASTROPODA			
Nassarius trivittatus	6.25	0.03	
BIVALVIA			
Tellina agilis	6.25	0.03	
Mya arenaria	12.5	0.7	
TOTAL	19,181.25	99.9	

Field Notes: Chelsea River western station; silty sand, 1.0mm redox layer and some polychaete tubes present.

Table 11. Benthic samples from Boston Harbor ($0.04m^2$ Van Veen Grab and 0.5mm sieve).

STUDY SITE = BOSTON HARBOR, MA

STATION = 11 SAMPLING DATE = 7-2-86

TAXA	$\#/m^2$	% Total Ni	Rank
NEMERTINEA			
Nemertines	12.5	0.2	
POLYCHAETA			
Harmothoe imbricata	18.75	0.3	
Pholoe minuta	43.75	0.6	
Anaitides mucosa	6.25	0.1	
Eteone flava	881.25	13.0	2
Microphthalmus aberrans	6.25	0.1	
Autolytus cornutus	12.5	0.2	
Nereis virens	25.0	0.4	
Ophryotrocha puerilis	6.25	0.1	
Polydora caulleryi	56.25	0.8	
Polydora quadrilobata	43.75	0.6	
Polydora ligni	268.75	4.0	
Polydora aggregata	875.0	13.0	2
Prionospio (P.) steenstrupi	18.75	0.3	
Spio filicornis	575.0	8.5	5
Spio armata	612.5	9.1	4
Streblospio benedicti	131.25	1.9	
Trochochaeta multisetosa	6.25	0.1	
Cirratulidae sp. (fragment)	37.5	0.6	
Cirratulidae cirratus	6.25	0.1	
Caulleriella sp.	50.0	0.7	
Pherusa plumosa	25.0	0.4	
Capitella capitata	2212.5	32.7	1
Asabellides oculata	6.25	0.1	
OLIGOCHAETA			
Tubificoides spp.	800.0	11.8	3
GASTROPODA			
Nassarius trivittatus	12.5	0.2	

TAXA	#/m^2	% Total Ni	Rank
BIVALVIA			
Modiolus sp. (juvenile)	6.25	0.1	
TOTAL	6756.25	100.0	

Field Notes: Chelsea River middle station; silty sediment, 1mm redox layer strong oil (smell and visible sheen) and polychaete tubes present.

Table 12. Benthic samples from Boston Harbor (0.04m^2 Van Veen Grab and 0.5mm sieve).

STUDY SITE = BOSTON HARBOR, MA

STATION = 12 SAMPLING DATE = 7-2-86

TAXA	#/m^2	% Total Ni	Rank
POLYCHAETA			
Pholoe minuta	12.5	0.4	
Eteone flava	37.5	1.1	
Microphthalmus aberrans	156.25	4.6	2
Nereis virens	6.25	0.2	
Polydora quadrilobata	6.25	0.2	
Polydora ligni	112.5	3.3	5
Polydora aggregata	6.25	0.2	
Spio armata	6.25	0.2	
Streblospio benedicti	137.5	4.0	3
Caulleriella sp.	18.75	0.5	
Capitella capitata	2762.5	81.0	1
OLIGOCHAETA			
Oligochaeta	18.75	0.5	
Tubificoides spp.	131.25	3.8	4
TOTAL	3412.5	100.0	

Field Notes: Chelsea River eastern station; silty sediment <1mm redox layer, some oil (odor and sheen) and polychaete tubes present.

Table 13. Benthic samples from Boston Harbor ($0.04m^2$ Van Veen Grab and 0.5mm sieve).

STUDY SITE = BOSTON HARBOR, MA

STATION = 13 SAMPLING DATE = 7-2-86

TAXA	$\#/m^2$	% Total Ni	Rank
POLYCHAETA			
Harmothoe imbricata	6.25	0.1	
Pholoe minuta	181.25	1.9	
Anaitides mucosa	50.0	0.5	
Anaitides maculata	12.5	0.2	
Eteone flava	1281.25	13.1	2
Microphthalmus aberrans	87.5	0.9	
Autolytus cornutus	12.5	0.1	
Nephtys caeca	25.0	0.3	
Polydora socialis	31.25	0.3	
Polydora caulleryi	25.0	0.3	
Polydora quadrilobata	6.25	0.1	
Polydora ligni	1175.0	12.0	3
Polydora aggregata	5337.5	54.6	1
Prionospio (P.) steenstrupi	37.5	0.4	
Spio filicornis	106.25	1.1	
Spio cf. limicola	6.25	0.1	
Spio armata	393.75	4.0	4
Streblospio benedicti	156.25	1.6	
Trochochaeta multisetosa	12.5	0.1	
Cirratulidae sp. (fragment)	200.0	2.0	
Caulleriella sp.	131.25	1.3	
Pherusa plumosa	12.5	0.1	
Capitella capitata	206.25	2.1	
Ampharete arctica	37.5	0.4	
Sabellidae sp. (juvenile)	6.25	0.1	
OLIGOCHAETA			
Oligochaeta	12.5	0.1	
Tubificoides spp.	225.0	2.3	5
CRUSTACEA			
Corophium sp. (juvenile)	6.25	0.1	
TOTAL	9,781.25	100.2	

Field Notes: Confluence of Chelsea and Mystic Rivers; silty sand over clay, 1-2mm redox layer, numerous polychaete tubes.

Table 14. Benthic samples from Boston Harbor (0.04m^2 Van Veen Grab and 0.5mm sieve).

BOSTON HARBOR, MASSACHUSETTS
NOVEMBER 18-20, 1986

STATION 1

NO ORGANISMS FOUND

Field Notes: Reserve Channel, silty sediment, 0 to <1mm redox layer, strong H_2S odor present.

Table 15. Benthic samples from Boston Harbor (0.04m^2 Van Veen Grab and 0.5mm sieve).

BOSTON HARBOR, MASSACHUSETTS
NOVEMBER 18-20, 1986

STATION 2	#/m^2	% Total Ni	Rank
POLYCHAETA			
Spionidae			
Polydora ligni	18.75	60.0	1
BIVALVIA			
Modiolus modiolus (set)	6.25	20.0	2
CRUSTACEA			
AMPHIPODA			
Ampelisca abdita	6.25	20.0	2
TOTAL INDIVIDUALS	31.25	100.0	
TOTAL SPECIES	3		

Field Notes: Turning area at the confluence of the Reserved Channel and the Mainship Channel, silty sediment, patchy 2.5-10mm redox layer.

Table 16. Benthic samples from Boston Harbor ($0.04m^2$ Van Veen Grab and 0.5mm sieve).

BOSTON HARBOR, MASSACHUSETTS
NOVEMBER 18-20, 1986

STATION 3	$\#/m^2$	% Total Ni	Rank
POLYCHAETA			
Nereidae			
Nereis virens	6.25	100.0	1
TOTAL INDIVIDUALS	6.25	100.0	
TOTAL SPECIES	1		

Field Notes: Mainship Channel across from Fish Pier; silty sediment, patchy 1mm redox.

Table 17. Benthic samples from Boston Harbor ($0.04m^2$ Van Veen Grab and 0.5mm sieve).

BOSTON HARBOR, MASSACHUSETTS
NOVEMBER 18-20, 1986

STATION 4	$\#/m^2$	% Total Ni	Rank
OLIGOCHAETA			
Tubificidae	6.25	33.3	2
CRUSTACEA			
DECAPODA			
Pagurus acadianus	12.5	66.6	1
TOTAL INDIVIDUALS	18.75	99.9	
TOTAL SPECIES			

Field Notes: Mainship Channel between Fish Pier and Reserved Channel; sandy-silt sediment, patchy 1mm redox layer.

Table 18. Benthic samples from Boston Harbor (0.04m^2 Van Veen Grab and 0.5mm sieve).

BOSTON HARBOR, MASSACHUSETTS
NOVEMBER 18-20, 1986

STATION 5	#/m^2	% Total Ni	Rank
OLIGOCHAETA			
Tubificidae	550.0	28.5	2
POLYCHAETA			
Phyllodocidae			
Eteone flava	12.5	0.6	
Nephthyidae			
Nephtys sp. (immature)	6.25	0.3	
Spionidae			
Polydora ligni	418.75	21.7	3
Polydora sp.	12.5	0.6	
Spio sp. (immature)	62.5	3.2	5
Streblospio benedicti	687.5	35.6	1
Cirratulidae			
Tharyx acutus	100.0	5.2	4
Capitellidae			
Capitella capitata	6.25	0.3	
Syllidae			
Autolytus sp.	6.25	0.3	
BIVALVIA			
Bivalvia species (shell dissolved)	6.25	0.3	
Mya arenaria	25.0	1.3	
Modiolus modiulus	6.25	0.3	
GASTROPODA			
Nassarius trivittatus	6.25	0.3	
CRUSTACEA			
AMPHIPODA			
Ampelisca abdita	12.5	0.6	
CUMACEA			
Diastylis sp. (immature)	12.5	0.6	
TOTAL INDIVIDUALS	1931.25	99.7	
TOTAL SPECIES	16		

Field Notes: Mainship Channel across from the Reserved Channel; silt/shell over clay, 1 to 2mm redox layer.

Table 19. Benthic samples from Boston Harbor (0.04m^2 Van Veen Grab and 0.5mm sieve).

BOSTON HARBOR, MASSACHUSETTS
NOVEMBER 18-20, 1986

STATION 6	#/m^2	% Total Ni	Rank
RHYNCHOCOELA	8.3	0.1	
OLIGOCHAETA			
Tubificidae	8.3	0.1	
POLYCHAETA			
Sigalionidae			
Pholoe minuta	16.6	0.2	
Phyllodocidae			
Phyllodoce sp. (immature)	8.3	0.1	
Nephthyidae			
Nephtys sp. (immature)	100.0	1.4	
Spionidae			
Polydora ligni	1300.0	18.4	2
Polydora aggregata	16.6	0.2	
Prionispio steenstrupi	25.0	0.4	
Spio sp. (immature)	25.0	0.4	
Streblospio benedicti	733.3	10.4	4
Cirratulidae			
Tharyx acutus	275.0	3.9	5
Capitellidae			
Mediomastus ambiseta	8.3	0.1	
Syllidae			
Autolytus sp.	6.25	0.3	
BIVALVIA			
Mya arenaria	16.6	0.2	
Lyonsia sp. (immature)	8.3	0.1	
GASTROPODA			
Nassarius trivittatus	1141.7	16.2	3
CRUSTACEA			
AMPHIPODA			
Ampelisca abdita	2991.7	42.4	1
Leptocheirus pinguis	8.3	0.1	
Photis macrocoxa	225.0	3.2	
Unciola irrorata	25.0	0.4	
Gammarus sp.	8.3	0.1	

TAXA	#/m^2	% Total Ni	Rank
CUMACEA			
Diastylis sculpta	16.6	0.2	
Diastylis polita	16.6	0.2	
Diastylis sp. (immature)	16.6	0.2	
ISOPODA			
Edotea triloba	41.7	0.6	
DECAPODA			
Crangon septemspinosa	8.3	0.1	
TOTAL INDIVIDUALS	7050.0	99.7	
TOTAL SPECIES	25		

N.B. Station 6 replicate B was not included in enumeration because of the large grain size of the sieved residue, which was in contrast to the other replicates.

Field Notes: Mainship Channel at President Roads anchorage; sand and silt, 1mm redox layer and amphipod tubes present.

Table 20. Benthic samples from Boston Harbor (0.04m^2 Van Veen Grab and 0.5mm sieve).

BOSTON HARBOR, MASSACHUSETTS
NOVEMBER 18-20, 1986

STATION 7

NO ORGANISMS FOUND

Field Notes: Mystic River western station; silty sediment, sediment, 0mm redox layer, strong H_2S smell (azoic).

Table 21. Benthic samples from Boston Harbor ($0.04m^2$ Van Veen Grab and 0.5mm sieve).

BOSTON HARBOR, MASSACHUSETTS
NOVEMBER 18-20, 1986

STATION 8	#/m^2	% Total Ni	Rank
GASTROPODA (immature)	6.25	50.0	1
CRUSTACEA			
DECAPODA			
Crangon septemspinosa	6.25	50.0	1
TOTAL INDIVIDUALS	12.5	100.0	
TOTAL SPECIES	2		

Field Notes: Mystic River central station; silty sediment, <1mm patchy redox layer, H_2S odor.

Table 22. Benthic samples from Boston Harbor ($0.04m^2$ Van Veen Grab and 0.5mm sieve).

BOSTON HARBOR, MASSACHUSETTS
NOVEMBER 18-20, 1986

STATION 9	#/m^2	% Total Ni	Rank
POLYCHAETA			
Spionidae			
Streblospio benedicti	6.25	100.0	1
TOTAL INDIVIDUALS	6.25		
TOTAL SPECIES	1		

Field Notes: Mystic River eastern station; silty sediment, 0 to 3mm patchy redox and H_2S odor.

Table 23. Benthic samples from Boston Harbor (0.04m^2 Van Veen Grab and 0.5mm sieve).

BOSTON HARBOR, MASSACHUSETTS
NOVEMBER 18-20, 1986

STATION 10	#/m^2	% Total Ni	Rank
POLYCHAEATA			
Spionidae			
Streblospio benedicti	68.75	100.0	1
TOTAL INDIVIDUALS	68.75		
TOTAL SPECIES	1		

Field Notes: Chelsea River western station; silty sand, 5mm patchy redox layer.

Table 24. Benthic samples from Boston Harbor (0.04m^2 Van Veen Grab and 0.5mm sieve).

BOSTON HARBOR, MASSACHUSETTS
NOVEMBER 18-20, 1986

STATION 11	#/m^2	% Total Ni	Rank
OLIGOCHAETA			
Tubificidae	6.25	25.0	1
Paleascolex sp.	6.25	25.0	1
POLYCHAEATA			
Capitellidae			
Capatella capitata	6.25	25.0	1
BIVALVIA			
Tellina agilis	6.25	25.0	1
TOTAL INDIVIDUALS	25.0		
TOTAL SPECIES	4		

Field Notes: Chelsea River middle station; silty sediment, 1mm redox layer.

Table 25. Benthic samples from Boston Harbor (0.04m^2 Van Veen Grab and 0.5mm sieve).

BOSTON HARBOR, MASSACHUSETTS
NOVEMBER 18-20, 1986

STATION 12

NO ORGANISMS FOUND

Field Notes: Chelsea River easter station; silty sediment, 1mm redox layer.

Table 26. Benthic samples from Boston Harbor (0.04m^2 Van Veen Grab and 0.5mm sieve).

BOSTON HARBOR, MASSACHUSETTS
NOVEMBER 18-20, 1986

STATION 13	#/m^2	% Total Ni	Rank
OLIGOCHAETA			
Tubificidae	56.25	56.3	1
POLYCHAEATA			
Spionidae			
Streblospio benedicti	12.5	12.5	3
Cirratulidae			
Tharyx acutus	31.25	31.3	
TOTAL INDIVIDUALS	100.00	100.1	
TOTAL SPECIES	3		

Field Notes: Confluence of Chelsea and Mystic Rivers, silty sand, 1 to 10mm redox layer.

Table 27. Station #1 - 95% Dominant Species from Boston Harbor (July and November 1986)

Station #1 July 1986

(no organisms recovered)

Station #1 November 1986

(no organisms recovered)

Table 28. Station #2 - 95% Dominant Species from Boston Harbor (July and November 1986)

Taxa Station #2	% Dominance	Ni/m^2 July 1986
Capitellla capitata	85.5	700.0
Eteone fleve	5.3	43.75
Anaitides mucosa	1.6	12.5
Spio armata	1.6	12.5
Streblospio benedicti	1.6	12.5
Oligochaeta	1.6	12.5
Tubificoides spp.	1.6	12.5
	98.8	806.25/818.8
Station #2		November 1986
Polydora ligni	60.0	18.75
Modiolus modiolus	20.00	6.25
Ampelisca abdita	20.00	6.25
	100.0	31.25/31.25

Table 29. Station #3 - 95% Dominant Species from Boston Harbor (July and November 1986)

Taxa Station #3	% Dominance	#/m^2
	July 1986	
Polydora aggregata	38.9	1181.25
Polydora ligni	24.5	743.75
Capitella capitata	12.8	387.5
Eteone flava	8.8	268.75
Spio armata	5.3	162.5
Nereis virens	1.4	43.75
Pholoe minuta	1.0	31.25
Tubificoides spp.	1.0	31.25
Anaitides mucosa	0.8	25.0
Microphthalmus aberrans	0.8	25.0
	95.3	2900/3037.5
Station #3	November 1986	
Nereis virens	100.0	6.25

Table 30. Station #4 - 95% Dominant Species from Boston Harbor (July and November 1986)

Taxa Station #4	% Dominance	#/m^2
	July 1986	
Polydora ligni	31.0	1868.75
Capitella capitata	27.6	1662.5
Polydora aggregata	21.9	1318.75
Eteone flava	9.7	581.25
Spio armata	1.3	81.25
Microphthalmus aberrans	1.0	62.5
Pholoe minuta	0.8	50.0
Anaitides mucosa	0.8	50.0
Tubificoides spp.	0.7	43.75
Hiatella sp. (juv.)	0.7	43.75
	95.5	5762.5/6018.75
Station #4	November 1986	
Pagurus acadianus	66.6	12.5
Tubificidae	33.3	6.25
	99.9	18.75/18.75

Table 31. Station #5 - 95% Dominant Species from Boston Harbor (July and November 1986)

Taxa Station #5	% Dominance	#/m^2
	July 1986	
Tubificoides spp.	18.8	1150.0
Polydora aggregata	11.0	675.0
Spio armata	9.5	581.25
Polydora ligni	8.6	525.0
Nephtys caeca	4.8	293.75
Microphthalmus aberrans	4.7	287.5
Nereis virens	4.6	281.25
Eteone flava	4.5	275.0
Pholoe minuta	4.2	256.25
Caulleriella sp.	4.1	250.0
Prionospio steenstrupi	3.5	212.5
Spio filicornis	3.0	181.25
Streblospio benedicti	2.2	137.5
Modiolus sp. (juv)	2.0	125.0
Anaitides mucosa	1.9	118.75
Capitella capitata	1.6	100.0
Ampelisca abdita	1.4	87.5
Harmothoe imbricata	1.2	75.0
Polydora quadrilobata	1.1	68.75
Spio cf. limicola	0.9	56.25
Nassarius trivittatus	0.9	56.25
Unciola irrorata	0.6	37.5
	95.1	5831.25/6125.0
Station #5	November 1986	
Streblospio benedicti	35.6	687.5
Tubificidae	28.75	550.0
Polydora ligni	21.7	418.75
Tharyx acutus	5.2	100.0
Spio sp. (immature)	3.2	62.5
Mya arenaria	1.3	25.0
	95.5	1843.75/1931.25

Table 32. Station #6 - 95% Dominant Species from Boston Harbor (July and November 1986)

Taxa Station #6	% Dominance	#/m^2
	July 1986	
Nephtys caeca	29.5	818.75
Ampelisca abdita	19.8	550.0
Ensis directus	7.7	212.5
Nassarius trivittatus	6.5	181.25
Polydora ligni	6.1	168.75
Nereis virens	4.3	118.75
Diastylis sculpta	2.9	81.25
Photis pollex	2.9	81.25
Spio cf. limicola	2.3	62.5
Prionospio steenstrupi	2.0	56.25
Streblospio benedicti	1.4	37.5
Mya arenaria	1.4	37.5
Dyopedos monacanthus	1.4	37.5
Anaitides mucosa	1.1	31.25
Polydora aggregata	1.1	31.25
Diastylis polita	0.9	25.0
Unciola irrorata	0.9	25.0
Pholoe minuta	0.7	18.75
Polydora quadrilobata	0.7	18.75
Spio armata	0.7	18.75
Caulleriella sp.	0.7	18.75
	97.0	2687.5/2775.0
Station #6	November 1986	
Ampelisca abdita	42.4	2991.7
Polydora ligni	18.4	1300.0
Nassarius trivittatus	16.2	1141.7
Streblospio benedicti	10.4	733.3
Tharyx acutus	3.9	275.0
Photis macrocoxa	3.2	225.0
Edotea triloba	0.6	41.7
	95.1	6708.4/7050.0

Table 33. Station #7 - 95% Dominant Species from Boston Harbor (July and November 1986)

Taxa	% Dominance	#/m^2
Station #7	July 1986	
(no organisms recovered)		
Station #7	November 1986	
(no organisms recovered)		

Table 34. Station #8 - 95% Dominant Species from Boston Harbor (July and November 1986)

Taxa	% Dominance	#/m^2
Station #8	July 1986	
Capitella capitata	90.5	356.25
Polydora aggregata	4.8	18.75
	95.3	393.75/412.3
Station #8	November 1986	
Gastropoda (immature)	50.0	6.25
Crangon septemspinosa	50.0	6.25
	100.0	12.5/12.5

Table 35. Station #9 - 95% Dominant Species from Boston Harbor (July and November 1986)

Taxa	% Dominance	#/m^2
Station #9	July 1986	
Capitella capitata	38.6	168.75
Polydora ligni	15.7	68.75
Caulleriella sp.	15.7	68.75
Polydora aggregata	12.9	56.25
Eteone flava	5.7	25.0
Nephtys sp. (juv)	2.9	12.5
Streblospio benedicti	2.9	12.5
Tubificoides spp.	2.9	12.5
	97.3	425.0/437.5
Station #9	November 1986	
Streblospio benedicti	100.0	6.25

Table 36. Station #10 - 95% Dominant Species from Boston Harbor (July and November 1986)

Taxa Station #10	% Dominance	#/m^2 July 1986
Polydora ligni	43.3	8300.0
Polydora aggregata	24.7	4743.75
Capitella capitata	8.2	1568.75
Eteone flava	6.1	1175.0
Spio armata	5.6	1075.0
Streblospio benedicti	2.6	493.75
Tubificoides spp.	2.4	456.25
Spio filicornis	2.3	450.0
	95.2	18262.5/19181.25
Station #10		November 1986
Streblospio benedicti	100.0	68.75

Table 37. Station #11 - 95% Dominant Species from Boston Harbor (July and November 1986)

Taxa Station #11	% Dominance	#/m^2 July 1986
Capitella capitata	32.7	2212.5
Eteone flava	13.0	881.25
Polydora aggregata	13.0	875.0
Tubificoides sp.	11.8	800.0
Spio armata	9.1	612.5
Spio filicornis	8.5	575.0
Polydora ligni	4.0	268.75
Streblospio benedicti	1.9	131.25
Polydora caulleryi	0.8	56.25
Caullerialla sp.	0.7	50.0
	95.5	6462.5/6756.25
Station #11		November 1986
Tunificidae	25.0	6.25
Pelescolex sp.	25.0	6.25
Capitella capitata	25.0	6.25
Tellina agilis	25.0	6.25
	100.0	25.0/25.0

Table 38. Station #12 - 95% Dominant Species from Boston Harbor (July and November 1986)

Taxa	% Dominance	#/m^2
Station #2	July 1986	
Capitella capitata	81.0	2762.5
Microphthalmus aberrans	4.6	156.25
Streblospio benedicti	4.0	137.5
Tubificoides spp.	3.8	131.25
Polydora ligni	3.3	112.5
	96.6	3300.0/3412.5
Station #12	November 1986	
(no organisms recovered)		

Table 39. Station #13 - 95% Dominant Species from Boston Harbor (July and November 1986)

Taxa	% Dominance	#/m^2
Station #13	July 1986	
Polydora aggregata	54.6	5337.5
Eteone flava	13.1	1281.25
Polydora ligni	12.0	1175.0
Spio armata	4.0	393.75
Tubificoidas spp.	2.3	225.0
Capitella capitata	2.1	206.25
Cirratulidae sp. (fragment)	2.0	200.0
Pholoe minuta	1.9	181.25
Streblospio benedicti	1.6	156.25
Caulleriella sp.	1.3	131.25
Spio filicornis	1.1	106.25
	96.0	9393.75/9781.25
Station #13	November 1986	
Tubificidae	56.25	56.25
Tharyx acutus	31.25	31.25
Streblospio benedicti	12.5	12.5
	100.0	100.0/100.0

Table 40. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 1 (July, 1986).

No organisms recovered

Table 41. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 2 (July, 1986).

Density and Richness
Total Number of Species = 9
Total Number of Individuals = 818.75

Shannon Diversity Index
H' = .2971
J' = .3114

Margalef Diversity Index
Da = 2.7462

Menhinick Diversity Index
DB = .3145

Simpson Diversity Index
L = .0032

Simpson Dominance Index
S = .9968

Simpson Evenness
Es = 1.12

Table 42. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 3 (July, 1986).

Density and Richness
Total Number of Species = 27
Total Number of Individuals = 3037.5

Shannon Diversity Index
H' = .8011
J' = .5597

Margalef Diversity Index
Da = 7.4659

Menhinick Diversity Index
DB = .4899

Simpson Diversity Index
L = .0009

Simpson Dominance Index
S = .9991

Simpson Evenness
Es = 1.0372

Table 43. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 4 (July, 1986).

Density and Richness
Total Number of Species = 28
Total Number of Individuals = 6018.75

Shannon Diversity Index
H' = .7729
J' = .5341

Margalef Diversity Index
Da = 7.1438

Menhinick Diversity Index
DB = .3609

Simpson Diversity Index
L = .0005

Simpson Dominance Index
S = .9995

Simpson Evenness
Es = 1.0363

Table 44. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 5 (July, 1986).

Density and Richness
Total Number of Species = 41
Total Number of Individuals = 6125

Shannon Diversity Index
H' = 1.2668
J' = .7855

Margalef Diversity Index
Da = 10.5622

Menhinick Diversity Index
DB = .5239

Simpson Diversity Index
L = .0004

Simpson Dominance Index
S = .9996

Simpson Evenness
Es = 1.0244

Table 45. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 6 (July, 1986).

Density and Richness
Total Number of Species = 32
Total Number of Individuals = 2775

Shannon Diversity Index
H' = 1.0798
J' = .7174

Margalef Diversity Index
Da = 9.003099

Menhinick Diversity Index
DB = .6075

Simpson Diversity Index
L = .0009

Simpson Dominance Index
S = .9991

Simpson Evenness
Es = 1.031

Table 46. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 7 (July, 1986).

No organisms recovered

Table 47. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 8 (July, 1986).

Density and Richness
Total Number of Species = 5
Total Number of Individuals = 393.75

Shannon Diversity Index
H' = .188
J' = .2689

Margalef Diversity Index
Da = 1.5413

Menhinick Diversity Index
DB = .252

Simpson Diversity Index
L = .0061

Simpson Dominance Index
S = .9939

Simpson Evenness
Es = 1.2392

Table 48. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 9 (July, 1986).

Density and Richness
Total Number of Species = 10
Total Number of Individuals = 437.25

Shannon Diversity Index
H' = .7824
J' = .7824

Margalef Diversity Index
Da = 3.4081

Menhinick Diversity Index
DB = .4782

Simpson Diversity Index
L = .0043

Simpson Dominance Index
S = .9957

Simpson Evenness
Es = 1.1038

Table 49. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 10 (July, 1986).

Density and Richness
Total Number of Species = 35
Total Number of Individuals = 19181.25

Shannon Diversity Index
H' = .7744
J' = .5015

Margalef Diversity Index
Da = 7.9386

Menhinick Diversity Index
DB = .2527

Simpson Diversity Index
L = .0002

Simpson Dominance Index
S = .9997999

Simpson Evenness
Es = 1.0292

Table 50. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 11 (July, 1986).

Density and Richness
Total Number of Species = 27
Total Number of Individuals = 6756.25

Shannon Diversity Index
H' = .9142999
J' = .6388

Margalef Diversity Index
Da = 6.789

Menhinick Diversity Index
DB = .3285

Simpson Diversity Index
L = .0004

Simpson Dominance Index
S = .9996

Simpson Evenness
Es = 1.0379

Table 51. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 12 (July, 1986).

Density and Richness
Total Number of Species = 13
Total Number of Individuals = 3412.5

Shannon Diversity Index
H' = .3704
J' = .3325

Margalef Diversity Index
Da = 3.3965

Menhinick Diversity Index
DB = .2225

Simpson Diversity Index
L = .0009

Simpson Dominance Index
S = .9991

Simpson Evenness
Es = 1.082

Table 52. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 13 (July, 1986).

Density and Richness
Total Number of Species = 28
Total Number of Individuals = 9781.25

Shannon Diversity Index
H' = .7392
J' = .5108

Margalef Diversity Index
Da = 6.7662

Menhinick Diversity Index
DB = .2831

Simpson Diversity Index
L = .0003

Simpson Dominance Index
S = .9997

Simpson Evenness
Es = 1.0366

Table 53. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 1 (November, 1986).

No organisms recovered.

Table 54. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 2 (November, 1986).

Density and Richness
Total Number of Species = 3
Total Number of Individuals = 31.25

Shannon Diversity Index
H' = .4127
J' = .865

Margalef Diversity Index
Da = 1.3379

Menhinick Diversity Index
DB = .5367

Simpson Diversity Index
L = .0358

Simpson Dominance Index
S = .9642

Simpson Evenness
Es = 1.4001

Table 55. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 3 (November, 1986).

(Only (1) one species recovered).

Table 56. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 4 (November, 1986).

Density and Richness
Total Number of Species = 2
Total Number of Individuals = 18.75

Shannon Diversity Index
H' = .2764
J' = .9183

Margalef Diversity Index
Da = .7855

Menhinick Diversity Index
DB = .4619

Simpson Diversity Index
L = .0561

Simpson Dominance Index
S = .9439

Simpson Evenness
Es = 1.787

Table 57. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 5 (November, 1986).

Density and Richness
Total Number of Species = 16
Total Number of Individuals = 1931.35

Shannon Diversity Index
H' = .7032
J' = .584

Margalef Diversity Index
Da = 4.565

Menhinick Diversity Index
DB = .3641

Simpson Diversity Index
L = .0013

Simpson Dominance Index
S = .9987

Simpson Evenness
Es = 1.0647

Table 58. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 6 (November, 1986).

Density and Richness
Total Number of Species = 26
Total Number of Individuals = 7055.65

Shannon Diversity Index
H' = .759
J' = .5364

Margalef Diversity Index
Da = 6.496

Menhinick Diversity Index
DB = .3095

Simpson Diversity Index
L = .0004

Simpson Dominance Index
S = .9996

Simpson Evenness
Es = 1.0394

Table 59. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 7 (November, 1986).

No organisms recovered.

Table 60. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 8 (November, 1986).

Density and Richness
Total Number of Species = 2
Total Number of Individuals = 12.5

Shannon Diversity Index
H' = .3011
J' = 1

Margalef Diversity Index
Da = .9117

Menhinick Diversity Index
DB = .5657

Simpson Diversity Index
L = .0692

Simpson Dominance Index
S = .9308

Simpson Evenness
Es = 1.7127

Table 61. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 9 (November, 1986).

(Only (1) one species recovered).

Table 62. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 10 (November, 1986).

(One (1) one species recovered).

Table 63. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 11 (November, 1986).

Density and Richness
Total Number of Species = 4
Total Number of Individuals = 25

Shannon Diversity Index
H' = .6021
J' = 1

Margalef Diversity Index
Da = 2.146

Menhinick Diversity Index
DB = .8

Simpson Diversity Index
L = .0332

Simpson Dominance Index
S = .9968

Simpson Evenness
Es = 1.2376

Table 64. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 12 (November, 1986).

No organisms recovered.

Table 65. Diversity Indices Calculated for Benthic Organisms at Boston Harbor Station 13 (November, 1986).

Density and Richness
Total Number of Species = 3
Total Number of Individuals = 100

Shannon Diversity Index
H' = .4113
J' = .862

Margalef Diversity Index
Da = 1

Menhinick Diversity Index
DB = .3

Simpson Diversity Index
L = .016

Simpson Dominance Index
S = .9839999

Simpson Evenness
Es = 1.4612

Table 66. Water column parameters for the Mainship Channel area of Boston Harbor (1986).

Location: Boston Harbor Station 6

Tide: Low (slack)

Date: 7/1/86 Time:0945

Secchi disk (meters): 3.3 /3.0 = 3.15m

Dissolved oxygen (0.3m) (ppm): 8.6

Weather: sunny, mild

	Temperature (Celsius)	Salinity 0/00
Air	26.7	—
Surface	14.0	26.6
1 meter	13.5	26.9
2 meters	13.5	26.8
3 meters	13.2	27.1
4 meters	13.2	27.1
5 meters	13.0	27.1
6 meters	13.0	27.1
7 meters	13.0	27.1
8 meters	13.0	27.1
9 meters	12.9	27.1
10 meters	12.9	27.1
11 meters	12.6	27.0
12 meters	12.5	27.3
13 meters	12.5	27.2

Table 67. Water column parameters for the Mainship Channel area of Boston Harbor (1986).

Location: Boston Harbor Station 5

Tide: Flood

Date: 7/1/86 Time:1510

Secchi disk (meters): 2.25 /2.5 = 2.38m

Dissolved oxygen (0.3m) (ppm): 9.0

Weather: partly cloudy, mild

	Temperature (Celsius)	Salinity 0/00
Air	25.0	—
Surface	17.2	26.0
1 meter	17.0	26.2
2 meters	17.0	26.5
3 meters	17.2	26.8
4 meters	17.0	27.0
5 meters	15.0	26.1
6 meters	14.3	26.6
7 meters	14.1	26.9
8 meters	14.0	26.9
9 meters	13.9	26.9
10 meters	13.9	26.8
11 meters	13.9	26.8
12 meters	13.9	24.0

Table 68. Water column parameters for the Mainship Channel area of Boston Harbor (1986).

Location: Boston Harbor Station 3

Tide: Flood

Date: 7/2/86 Time:1630

Secchi disk (meters): 1.5 /1.75 = 1.63m

Dissolved oxygen (0.3m) (ppm): 7.3

Weather: cold, rain

	Temperature (Celsius)	Salinity 0/00
Air	14.8	—
Surface	16.2	22.9
1 meter	16.75	22.5
2 meters	16.2	26.0
3 meters	15.9	26.5
4 meters	15.8	26.5
5 meters	15.8	26.5
6 meters	15.3	26.5
7 meters	14.9	27.1

Table 69. Water column parameters for the Mainship Channel area of Boston Harbor (1986).

Location: Station 6

Tide: Ebb

Date: 7/3/86 Time:1155

Secchi disk (meters): 2.5 /2.0 = 2.25m

Dissolved oxygen (0.3m) (ppm): 7.8

Weather: cloudy cool

	Temperature (Celsius)	Salinity 0/00
Air	19.2	—
Surface	16.5	25.5
1 meter	15.5	26.25
2 meters	15.0	26.5
3 meters	14.5	26.75
4 meters	14.5	26.75
5 meters	14.0	27.0
6 meters	14.0	27.25
7 meters	14.0	27.25
8 meters	14.0	27.25
9 meters	14.0	27.25
10 meters	14.0	27.25
11 meters	14.0	27.25
12 meters	14.0	27.25

Table 70. Water column parameters for the Reserve Channel area of Boston Harbor (1986).

Location: Boston Harbor Reserve Channel

Tide: Ebb

Date: 7/1/86 Time:1245

Secchi disk (meters): 3 /2.5 = 2.75m

Dissolved oxygen (0.3m) (ppm): 7.6

Weather: sunny, mild

	Temperature (Celsius)	Salinity 0/00
Air	26.7	—
Surface	19.0	25.0
1 meter	17.0	26.75
2 meters	16.0	26.75
3 meters	16.0	27.0
4 meters	16.0	27.0
5 meters	16.0	27.0
6 meters	15.5	27.0
7 meters	15.0	27.0
8 meters	15.0	27.0
9 meters	14.5	27.0
10 meters	14.0	27.0
11 meters	13.75	27.75
12 meters	13.5	27.25

Table 71. Water column parameters for the Mainship Channel area of Boston Harbor (1986).

Location: Boston Harbor Station 6

Tide: High

Date: 17/18/86 Time:1215

Secchi disk (meters): 3.5 /3.0 = 3.25m

Dissolved oxygen (0.3m) (ppm): 8.2

Weather: Partly overcast

	Temperature (Celsius)	Salinity 0/00
Air	11.75	—
Surface	9.25	18.5
1 meter	9.0	19.25
2 meters	9.0	19.75
3 meters	9.0	20.0
4 meters	8.75	20.5
5 meters	8.75	21.0
6 meters	8.75	21.0
7 meters	8.75	21.75
8 meters	8.75	22.0
9 meters	8.75	22.0
10 meters	8.75	22.0

Table 72. Water column parameters for the Charlestown area of Boston Harbor (1986).

Location: Coast Guard Dock Boston Harbor

Tide: Ebb

Date: 7/3/86 Time:1352

Secchi disk (meters): 1.3 /1.8 = 1.6m

Dissolved oxygen (0.3m) (ppm): 5.6

Weather: Cloudy - light rain

	Temperature (Celsius)	Salinity 0/00
Air	20.1	—
Surface	18.0	20.3
1 meter	17.3	21.2
2 meters	16.5	25.9
3 meters	16.0	26.1
4 meters	15.9	26.4
5 meters	15.4	26.3
6 meters	15.0	26.9
7 meters	15.0	26.8
8 meters	14.8	26.9
9 meters	14.0	27.0
10 meters	14.0	27.0
11 meters	14.0	27.0
12 meters	14.0	27.0
13 meters	14.0	27.0
14 meters	14.0	27.0

Table 73 - Water column parameters for the Charlestown area of Boston Harbor (1986).

Location: Boston Harbor Coast Guard Dock

Tide: High

Date: 7/3/86 Time:0745

Secchi disk (meters): 2 /1.7 = 1.85m

Dissolved oxygen (0.3m) (ppm): 5.4

Weather: cloudy, misting

	Temperature (Celsius)	Salinity 0/00
Air	15.9	—
Surface	17.3	17.9
1 meter	17.1	22.5
2 meters	16.2	26.0
3 meters	16.0	26.1
4 meters	15.5	26.1
5 meters	15.2	26.5
6 meters	15.0	26.5
7 meters	15.8	26.6
8 meters	14.5	26.5
9 meters	14.2	26.6
10 meters	13.9	26.8
11 meters	13.9	26.8
12 meters	13.9	26.9
13 meters	13.8	26.8

Table 74. Water column parameters for the Charlestown area of Boston Harbor (1986).

Location: Boston Harbor Coast Guard Dock

Tide: Flood

Date: 7/2/86 Time:1700

Secchi disk (meters): 1.25 /1.0 = 1.13m

Dissolved oxygen (0.3m) (ppm): 4.4

Weather: cloudy, rain

	Temperature (Celsius)	Salinity 0/00
Air	14.9	—
Surface	18.1	14.3
1 meter	17.4	22.0
2 meters	17.2	25.0
3 meters	17.2	26.0
4 meters	17.0	26.2
5 meters	16.1	26.0
6 meters	15.5	26.2
7 meters	15.2	26.3
8 meters	14.8	26.3
9 meters	14.2	26.8
10 meters	14.0	26.4
11 meters	13.9	26.1
12 meters	13.9	26.0
13 meters	13.9	26.0
14 meters	13.9	25.9

Table 75. Water column parameters for the Charlestown area of Boston Harbor (1986).

Location: Boston Harbor Coast Guard Dock

Tide: Low

Date: 7/2/86 Time:0727

Secchi disk (meters): 2.5 /2.2 = 2.4m

Dissolved oxygen (0.3m) (ppm): 6.7

Weather: rain

	Temperature (Celsius)	Salinity 0/00
Air	15.0	—
Surface	12.0	24.0
1 meter	17.0	26.0
2 meters	17.0	26.0
3 meters	16.0	26.5
4 meters	16.0	26.5
5 meters	15.5	26.5
6 meters	15.0	27.0
7 meters	15.0	27.0
8 meters	14.5	27.0
9 meters	14.0	27.0
10 meters	14.0	27.0

Table 76. Water column parameters for the Charlestown area of Boston Harbor (1986).

Location: Coast Guard Dock

Tide: Low

Date: 11/20/86 Time:0650

Secchi disk (meters): 8.15 /9.0 = 8.88m

Dissolved oxygen (0.3m) (ppm): 7.2

Weather: clear, calm and cold

	Temperature (Celsius)	Salinity 0/00
Air	off scale	—
Surface	8	20.50
1 meter	8.75	21.90
2 meters	9.0	21.20
3 meters	9.0	21.20
4 meters	9.0	21.50
5 meters	9.0	21.60
6 meters	9.0	21.90
7 meters	9.0	21.90
8 meters	9.0	21.90
9 meters	9.0	21.90
10 meters	9.0	21.90
11 meters	9.0	21.90
12 meters	9.0	21.90
13 meters	9.0	21.90
14 meters	9.0	21.90

Table 77. Water column parameters for the Mystic River area of Boston Harbor (1986).

Location: Boston Harbor Mystic River

Tide: Flood

Date: 7/2/86 Time:1400

Secchi disk (meters): 1 /0.9 = 0.95m

Dissolved oxygen (0.3m) (ppm): not determined

Weather: cold, rain

	Temperature (Celsius)	Salinity 0/00
Air		—
Surface	19.0	17.0
1 meter	18.5	22.25
2 meters	18.1	23.75
3 meters	18.6	24.5
4 meters	18.2	25.4
5 meters	17.25	25.6
6 meters	15.75	26.3
7 meters	14.9	26.8
8 meters	14.6	26.75
9 meters	14.2	26.75
10 meters	14.25	26.75
11 meters	14.1	26.75
12 meters	13.9	27.0
13 meters	13.9	27.0

Table 78. Water column parameters for the Mystic River area of Boston Harbor (1986).

Location: Station 8 Mystic River

Tide: High

Date: 11/20/86 Time:1303

Secchi disk (meters): 3.5 /3 = 3.25m

Dissolved oxygen (0.3m) (ppm): 7.3

Weather: clear, cold

	Temperature (Celsius)	Salinity 0/00
Air	5.0	—
Surface	11.0	22.0
1 meter	11.5	22.75
2 meters	11.5	22.75
3 meters	10.5	21.75
4 meters	10.25	22.0
5 meters	10.0	22.0
6 meters	10.0	21.5
7 meters	9.0	22.0
8 meters	9.0	21.75
9 meters	9.0	21.75
10 meters	8.75	22.0
11 meters	8.75	22.0
12 meters	8.75	22.0
13 meters	8.75	22.0
14 meters	8.75	22.0

Table 79. Water column parameters for the Chelsea River area of Boston Harbor (1986).

Location: Boston Harbor Station 12

Tide: Ebb

Date: 7/2/86 Time:0932

Secchi disk (meters): 1.7 /1.4 = 1.6m

Dissolved oxygen (0.3m) (ppm): 8.1

Weather: Cold, rain

	Temperature (Celsius)	Salinity 0/00
Air	15.0	—
Surface	16.25	25.5
1 meter	17.0	25.0
2 meters	17.0	25.0
3 meters	17.0	25.5
4 meters	16.0	25.5
5 meters	16.0	26.0
6 meters	16.0	26.0
7 meters	16.0	26.0
8 meters	15.5	26.0
9 meters	15.5	26.0
10 meters	15.0	26.5
11 meters	15.0	26.5
12 meters	15.0	26.5
13 meters	15.0	26.5

Table 80. Water column parameters for the Chelsea River area of Boston Harbor (1986).

Location: Chelsea Station 12

Tide: Flood

Date: 11/20/86 Time:0930

Secchi disk (meters): 3.5 /3.25 = 3.4m

Dissolved oxygen (0.3m) (ppm): not determined

Weather: clear, calm and cold

	Temperature (Celsius)	Salinity 0/00
Air	-1	—
Surface	6.5	22.0
1 meter	7.0	22.0
2 meters	7.25	22.0
3 meters	7.0	22.0
4 meters	7.5	22.0
5 meters	7.5	22.0
6 meters	7.5	22.0
7 meters	7.5	22.0
8 meters	7.5	22.0
9 meters	7.5	22.0
10 meters	7.75	22.0
11 meters	7.75	22.0
12 meters	7.75	22.0
13 meters	7.75	22.0

Table 81. Finfish Sampling in Boston Harbor July 1986

Harbor Region: Outer Mainship Channel

Type of Gear: Gillnets

Number of deployments: 4 (2 demersal and 2 pelagic)

Length of deployments: 6 hours each

Species	Total Number	Average Total Length (cm) (± S.D)	Average Weight (kg) (± S.D.)
Pseudopleuronectes americanus	6	33.3 (± 7.0)	0.46
Osmerus mordax	2	16.75 (± 0.35)	-
Alosa pseudoharengus	1	22.0	-
Brevoortia tyrannus	1	35.0	1.0
Homarus americanus	2 (1 male, 1 female)	7.5 (± 0.42)	0.5
Cancer borealis	4 (4 female)	10.55 (± 0.66)	0.28 (± 0.06)

Table 82. Finfish Sampling in Boston Harbor November 1986

Harbor Region: Outer Mainship Channel

Type of Gear: Gillnets

Number of deployments: 4 (2 demersal and 2 pelagic)

Length of deployments: 6 hours each

Species	Total Number	Average Total Length (cm) (± S.D.)	Average Weight (kg) (± S.D.)
Pseudopleuronectes americanus	24 (63 % female)	16.6 (± 11.3)	0.5 (± 0.16)
scophthalmus Aquosus	1 (female)	26.0	0.25
Scomber scombrus	1 (male)	24.0	0.15
Alosa aestivalis	1 (male)	15.9	-
Myoxocephalus octodecemspinosus	1 (female)	28.7	0.25
Cancer borealis	12 (66.7% male)	9.1 (± 1.8)	0.04

Carcinus maenas	1 (male)	6.1

Note: Ectoparasitic infection on all *Pseudopleuronectes americanus*

Table 83. Finfish Sampling in Boston Harbor July 1986

Harbor Region: Mainship Channel

Type of Gear: Gillnets

Number of deployments: 2 (demersal)

Length of deployments: 6 hours each

Species	Total Number	Average Total Length (cm) (± S.D.)	Average Weight (kg) (± S.D.)
Pseudopleuronectes americanus	2	28.5 (± 0.12)	0.48 (± 0.004)
Scophthalmus aquosus	1	29.0	0.45
Osmerus mordax	1	15.2	

Table 84. Finfish Sampling in Boston Harbor November 1986

Harbor Region: Mainship Channel

Type of Gear: Gillnets

Number of deployments: 2 (demersal)

Length of deployments: 6 hours each

Species	Total Number	Average Total Length (cm) (± S.D.)	Average Weight (kg) (± S.D.)
Pseudopleuronectes americanus	5	18.6 (± 9.97)	0.2
Osmerus mordax	4	18.4 (± 3.0)	-
Scopthalmus aquosus	2	13.2 (± 4.7)	-
Microgadus tomcod	1 (female)	23.5	0.4
Cancer borealis	5 (60% male)	6.9 (± 0.5)	0.12
Carcinus maenas	1	3.2	-

Table 85. Finfish Sampling in Boston Harbor July 1986

Harbor Region: Chelsea River

Type of Gear: Gillnets

Number of deployments: 6 (2 pelagic, 4 demersal)

Length of deployments: 6 hours each

Species	Total Number	Average Total Length (cm) (± S.D.)	Average Weight (kg) (± S.D.)
Osmerus mordax	4	16.0 (± 1.1)	
Alosa pseudoharengus	1	26.5	0.25
Brevoortia tyrannus	1	23.0	-
Carcinus maenas	4 (100% female)	6.3 (± 0.97)	-
Libinia emarginata	1	6.7	0.2

Table 86. Finfish Sampling in Boston Harbor November 1986

Harbor Region: Chelsea River

Type of Gear: Gillnets

Number of deployments: 2 (demersal)

Length of deployments: 6 hours each

Species	Total Number	Average Total Length (cm) (± S.D.)	Average Weight (kg) (± S.D.)
None			

Table 87. Finfish Sampling in Boston Harbor July 1986

Harbor Region: Mystic River

Type of Gear: Gillnets

Number of deployments: 2 (demersal)

Length of deployments: 6 hours each

Species	Total Number	Average Total Length (cm) (± S.D.)	Average Weight (kg) (± S.D.)
Osmerus mordax	1	15.5	
Carcinus maenas	24 (100% female)	3.34 (± 1.59)	0.015

Table 88. Finfish Sampling in Boston Harbor July 1986

Harbor Region: Mystic River

Type of Gear: Otter Trawl

Number of deployments: 9

Length of deployments: 5 minutes each

Species	Total Number	Average Total Length (cm) (± S.D.)	Average Weight (kg) (± S.D.)

None

Table 89. Finfish Sampling in Boston Harbor November 1986

Harbor Region: Mystic River

Type of Gear: Gillnets

Number of deployments: 2 (demersal)

Length of deployments: 6 hours each

Species	Total Number	Average Total Length (cm) (± S.D.)	Average Weight (kg) (± S.D.)
Osmerus mordax	1	19.0	
Carcinus maenas	16 (75% female)	4.82 (± 0.67)	0.03

Table 90. Finfish Sampling in Boston Harbor November 1986

Harbor Region: Mystic River

Type of Gear: Otter Trawl

Number of deployments: 4

Length of deployments: 5 minutes each

Species	Total Number	Average Total Length (cm) (± S.D.)	Average Weight (kg) (± S.D.)
Pseudopleuronectes americanus	443 (58.3% male)	9.59 (± 3.51)	0.014
Scophthalmus aquosus	23	8.87 (±4.19)	0.018
Alosa aestivalis	12	11.2 (±1.67)	-
Osmerus mordax	14 (66.6% Female)	13.1 (± 3.95)	-
Menidia menidia	7	11.1 (± 4.20)	-
Myoxocephalus octodecemspinosus	2	8.3 (± 0.42)	-
Crangon septemspinosa	5796	-	(3.62 total)
Carcinus maenas	72 (50% female)	4.54 (± 1.12)	0.026

APPENDIX III

MACROBENTHIC INVERTEBRATE

IDENTIFICATIONS

LIST OF MACROBENTHIC INVERTEBRATE SPECIES
BOSTON HARBOR, MASSACHUSETTS
COLLECTED JULY 2 & 3, 1986

TAXA	SPECIES CODE
POLYCHAETA	
Ampharetidae	5001670000
Ampharete arctica	5001670201
Asabellides oculata	5001670802
Capitellidae	5001600000
Capitella capitata	5001600101
Mediomastus californiensis	5001600402
Cirratulidae	5001500000
Cirratulidae sp. (fragment)	5001500000
Cirratulus cirratus	5001500101
Caulleriella sp.	5001500305
Dorvilleidae	5001360000
Ophryotrocha puerilis	5001360401
Schistomeringos caeca	5001360505
Flabelligeridae	5001540000
Pherusa plumosa	5001540302
Glyceridae	5001270000
Glycera dibranchiata	5001270105
Hesionidae	5001210000
Microphthalmus aberrans	5001210202
Nephtyidae	5001250000
Nephtys caeca	5001250103
Nephtys sp. (juvenile)	5001250199
Nereidae	5001240000
Nereis virens	5001240412
Pectinariidae	5001660000
Pectinaria granulata	5001660303
Phyllodocidae	5001130000
Anaitides maculata	5001130106
Anaitides mucosa	5001130104
Anaitides sp. (juvenile)	5001130199
Eteone flava	5001130204
Eteone heteropoda	5001130207

Polynoidae	5001020000
Harmothoe imbricata	5001020806
Polynoidae sp. (juvenile)	5001029999
Sabellidae	5001700000
Sabellidae sp. (juvenile)	5001709999
Sigalionidae	5001060000
Pholoe minuta	5001060101
Spionidae	5001430000
Polydora aggregata	5001430438
Polydora caulleryi	5001430404
Polydora ligni	5001430411
Polydora quadrilobata	5001430408
Polydora socialis	5001430402
Prionospio (P.) steenstrupi	5001430506
Spio armata	5001430709
Spio filicornis	5001430701
Spio cf. limicola	5001430707
Spio setosa	5001430704
Spiophanes bombyx	5001431001
Streblospio benedicti	5001431801
Syllidae	5001230000
Autolytus cornutus	5001230101
Autolytus sp. (Polybostrichus)	5001230100
Terebellidae	5001680000
Amphitrite figulus	5001680105
Polycirrus sp.	5001680800
Trochochaetidae	5001450000
Trochochaeta multisetosa	5001450102
MOLLUSCA	
Bivalvia	
*Bivalve sp. (juvenile)	5599999999
Hiatellidae	5517060000
Hiatella arctica	5517060201
Hiatella sp. (juvenile)	5517060299
Myidae	5517010000
Mya arenaria	5517010201
Mytilidae	5507010000
Modiolus modiolus	5507010601
Modiolus sp. (juvenile)	5507010699

*probably Tellina sp.

Solenidae	5515290000
Ensis directus	5515290301
Tellinidae	5515310000
Tellina agilis	5515310205
Tellina sp. (juvenile)	5515310299
Gastropoda	
Nassariidae	5105080000
Nassarius trivittatus	5105080103
CRUSTACEA	
Amphipoda	
Ampeliscidae	6169020000
Ampelisca abdita	6169020108
Aoridae	6169060000
Aoridae sp. (juvenile)	6169069999
Unciola irrorata	6169150703
Corophiidae	6169150000
Corophium sp. (juvenile)	6169150299
Haustoriidae	6169220000
Amphiporeia virginiana	6169220701
Isaeidae	6169260000
Photis pollex	6169260215
Lysianassidae	6169340000
Orchomene minuta	6169342901
Podoceridae	6169440000
Dyopedos monacanthus	6169440104
Cumacea	
Diastylidae	6154050000
Diastylis sculpta	6154050120
Diastylis polita	6154050121
Isopoda	
Idoteidae	6162020000
Edotea triloba	6162020703
Decapoda (Caridea)	
Crangonidae	6179220000
Crangon septemspinosa	6179220103

MISCELLANEOUS

Nemertinea	4300000000
Oligochaeta	5004000000
Tubificoides spp.	5009020900

STUDY SITE = BOSTON HARBOR MA

STATION = 2 SAMPLING DATE = 7-3-86

TAXA		REP 1	REP 2	REP 3	REP 4	SUM
POLYCHAETA						
Anaitides mucosa		0	1	1	0	2
Eteone flava		2	0	5	0	7
Microphthalmus aberrans		0	0	1	0	1
Polydora aggregata		0	0	1	0	1
Spio armata		0	0	2	0	2
Streblospio benedicti		2	0	0	0	2
Capitella capitata		43	29	16	24	112
OLIGOCHAETA						
Oligochaeta		1	1	0	0	2
Tubificoides spp.		0	1	1	0	2
TOTAL	9	48	32	27	24	131

STUDY SITE = BOSTON HARBOR MA

STATION = 3 SAMPLING DATE = 7-2-86

TAXA		REP 1	REP 2	REP 3	REP 4	SUM
POLYCHAETA						
Polynoidae sp. (juvenile)		0	0	0	1	1
Pholoe minuta		3	1	0	1	5
Anaitides mucosa		0	3	0	1	4
Anaitides maculata		0	1	0	0	1
Eteone flava		2	18	0	23	43
Microphthalmus aberrans		0	1	0	3	4
Autolytus cornutus		1	0	0	0	1
Nereis virens		0	7	0	0	7
Nephtys caeca		0	1	0	0	1
Polydora quadrilobata		0	0	0	1	1
Polydora ligni		25	55	0	39	119
Polydora aggregata		37	32	0	120	189
Prionospio (P.) steenstrupi		0	1	0	0	1
Spio filicornis		1	1	0	0	2
Spio setosa		0	1	0	0	1
Spio armata		6	17	0	3	26
Streblospio benedicti		0	1	0	0	1
Cirratulidae sp. (fragment)		0	2	0	0	2
Caulleriella sp.		0	0	0	1	1
Capitella capitata		3	3	0	56	62
OLIGOCHAETA						
Oligochaeta		0	0	0	1	1
Tubificoides spp.		0	5	0	0	5
GASTROPODA						
Nassarius trivittatus		0	1	0	0	1
BIVALVIA						
Modiolus modiolus		0	2	0	0	2
Hiatella sp. (juvenile)		0	3	0	0	3
CRUSTACEA						
Corophium sp. (juvenile)		0	0	0	1	1
Amphiporeia virginiana		0	0	0	1	1
TOTAL	27	78	156	0	252	486

STUDY SITE = BOSTON HARBOR MA

STATION = 4 SAMPLING DATE = 7-2-86

TAXA		REP 1	REP 2	REP 3	REP 4	SUM
NEMERTINEA						
Nemertinea		1	0	0	0	1
POLYCHAETA						
Harmothoe imbricata		0	2	0	0	2
Polynoidae sp. (juvenile)		0	1	1	0	2
Pholoe minuta		0	8	0	0	8
Anaitides mucosa		0	8	0	0	8
Anaitides maculata		0	1	0	0	1
Anaitides sp. (juvenile)		0	1	0	0	1
Eteone flava		5	46	4	38	93
Microphthalmus aberrans		0	8	1	1	10
Nereis virens		0	5	1	0	6
Nephtys caeca		0	1	0	0	1
Polydora caulleryi		0	1	0	0	1
Polydora ligni		0	272	3	24	299
Polydora aggregata		0	204	2	5	211
Prionospio (P.) steenstrupi		0	2	0	0	2
Spio filicornis		0	4	2	0	6
Spio armata		0	12	1	0	13
Spiophanes bombyx		0	1	0	0	1
Streblospio benedicti		0	2	0	2	4
Pherusa plumosa		0	2	0	0	2
Capitella capitata		137	20	12	97	266
Pectinaria granulata		0	1	0	0	1
Ampharete arctica		0	0	1	0	1
OLIGOCHAETA						
Tubificoides spp.		2	2	0	3	7
GASTROPODA						
Nassarius trivittatus		0	6	0	0	6
BIVALVIA						
Modiolus modiolus		0	1	0	0	1
Hiatella sp. (juvenile)		0	7	0	0	7
CRUSTACEA						
Diastylis sculpta		0	2	0	0	2
TOTAL	28	145	620	28	170	963

STUDY SITE = BOSTON HARBOR MA

STATION = 5 SAMPLING DATE = 7-3-86

TAXA		REP 1	REP 2	REP 3	REP 4	SUM
NEMERTINEA						
Nemertinea		1	1	0	0	2
POLYCHAETA						
Harmothoe imbricata		7	1	1	3	12
Pholoe minuta		16	16	5	4	41
Anaitides mucosa		8	6	1	4	19
Eteone flava		7	26	5	6	44
Microphthalmus aberrans		4	0	41	1	46
Autolytus sp. (Polybostrichus)		0	0	1	0	1
Nereis virens		8	14	6	17	45
Nephtys caeca		19	5	4	19	47
Schistomeringos caeca		0	0	1	0	1
Polydora socialis		0	0	0	2	2
Polydora quadrilobata		4	1	5	1	11
Polydora ligni		21	49	1	13	84
Polydora aggregata		45	31	6	26	108
Prionospio (P.) steenstrupi		17	5	5	7	34
Spio filicornis		12	4	10	3	29
Spio cf. limicola		0	1	1	7	9
Spio armata		14	28	30	21	93
Streblospio benedicti		11	4	0	7	22
Trochochaeta multisetosa		0	0	2	3	5
Cirratulidae sp. (fragment)		1	1	2	0	4
Caulleriella sp.		20	9	2	9	40
Pherusa plumosa		1	0	2	2	5
Capitella capitata		8	2	1	5	16
Mediomastus californiensis		2	0	0	1	3
Pectinaria granulata		2	1	0	0	3
Ampharete arctica		0	1	0	0	1
Polycirrus sp.		1	0	0	0	1
OLIGOCHAETA						
Oligochaeta		0	2	0	0	2
Tubificoides spp.		100	24	49	11	184
GASTROPODA						
Nassarius trivittatus		0	3	5	1	9
BIVALVIA						
Modiolus sp. (juvenile)		2	6	12	0	20
Tellina sp. (juvenile)		1	2	0	0	3
Mya arenaria		0	1	0	0	1
Hiatella arctica		0	0	1	2	3
Bivalvia sp. (juvenile)		0	0	1	2	3
CRUSTACEA						
Edotea triloba		0	0	1	2	3
Ampelisca abdita		3	3	0	8	14
Corophium sp. (juvenile)		0	2	0	0	2
Unciola irrorata		1	2	0	3	6
Photis pollex		1	0	1	0	2
TOTAL	41	337	251	202	190	980

STUDY SITE = BOSTON HARBOR MA

STATION = 6 SAMPLING DATE = 7-3-86

TAXA	REP 1	REP 2	REP 3	REP 4	SUM
POLYCHAETA					
Pholoe minuta	0	2	0	1	3
Anaitides mucosa	0	5	0	0	5
Anaitides sp. (juvenile)	1	0	0	0	1
Eteone flava	1	5	0	0	6
Nereis virens	4	3	3	9	19
Nephtys caeca	13	29	44	45	131
Polydora quadrilobata	0	0	1	2	3
Polydora ligni	6	12	2	7	27
Polydora aggregata	3	0	2	0	5
Prionospio (P.) steenstrupi	1	8	0	0	9
Spio filicornis	0	1	0	0	1
Spio cf. limicola	0	8	1	1	10
Spio armata	0	3	0	0	3
Streblospio benedicti	2	5	0	2	9
Caulleriella sp.	0	1	0	2	3
Capitella capitata	1	1	0	0	2
Mediomastus californiensis	0	1	0	0	1
Pectinaria granulata	1	0	0	1	2
GASTROPODA					
Nassarius trivittatus	2	17	5	5	29
BIVALVIA					
Modiolus sp. (juvenile)	1	1	0	0	2
Ensis directus	3	21	4	6	34
Tellina sp. (juvenile)	0	1	0	1	2
Mya arenaria	0	2	3	1	6
Hiatella sp. (juvenile)	0	1	0	0	1
CRUSTACEA					
Diastylis sculpta	0	8	4	1	13
Diastylis polita	1	2	0	1	4
Ampelisca abdita	24	48	6	10	88
Unciola irrorata	1	2	1	0	4
Photis pollex	1	5	2	5	13
Orchomene minuta	0	0	1	0	1
Dyopedos monacanthus	1	2	1	2	6
Crangon septemspinosa	1	0	0	0	1
TOTAL	32	68	194	80	102	444

STUDY SITE = BOSTON HARBOR MA

STATION = 8 SAMPLING DATE = 7-2-86

TAXA		REP 1	REP 2	REP 3	REP 4	SUM
POLYCHAETA						
Eteone flava		0	0	1	0	1
Microphthalmus aberrans		0	0	0	1	1
Polydora aggregata		0	1	2	0	3
Capitella capitata		12	27	8	10	57
CRUSTACEA						
Aoridae sp. (juvenile)		1	0	0	0	1
TOTAL	5	13	28	11	11	63

STUDY SITE = BOSTON HARBOR MA

STATION = 9 SAMPLING DATE = 7-2-86

TAXA		REP 1	REP 2	REP 3	REP 4	SUM
POLYCHAETA						
Eteone flava		3	0	0	1	4
Nephtys sp. (juvenile)		0	2	0	0	2
Polydora quadrilobata		0	1	0	0	1
Polydora ligni		11	0	0	0	11
Polydora aggregata		9	0	0	0	9
Spio filicornis		1	0	0	0	1
Streblospio benedicti		0	2	0	0	2
Caulleriella sp.		1	9	1	0	11
Capitella capitata		3	6	1	17	27
OLIGOCHAETA						
Tubificoides spp.		0	1	1	0	2
TOTAL	10	28	21	3	18	70

STUDY SITE = BOSTON HARBOR MA

STATION = 10 SAMPLING DATE = 7-2-86

TAXA		REP 1	REP 2	REP 3	REP 4	SUM
POLYCHAETA						
Pholoe minuta		6	2	1	24	33
Anaitides mucosa		0	1	0	3	4
Anaitides maculata		0	0	0	1	1
Anaitides sp. (juvenile)		0	1	1	0	2
Eteone flava		24	32	48	84	188
Eteone heteropoda		0	1	0	0	1
Microphthalmus aberrans		3	8	1	7	19
Autolytus cornutus		0	0	0	1	1
Nereis virens		1	1	0	3	5
Glycera dibranchiata		0	1	0	0	1
Polydora socialis		0	0	0	1	1
Polydora caulleryi		2	2	2	1	7
Polydora quadrilobata		1	1	2	0	4
Polydora ligni		129	35	250	914	1328
Polydora aggregata		95	32	139	493	759
Prionospio (P.) steenstrupi		2	0	8	3	13
Spio filicornis		5	23	18	26	72
Spio setosa		0	1	0	0	1
Spio cf. limicola		0	0	0	1	1
Spio armata		13	32	51	76	172
Streblospio benedicti		13	15	25	26	79
Trochochaeta multisetosa		0	0	1	1	2
Cirratulidae sp. (fragment)		2	12	10	5	29
Caulleriella sp.		2	1	1	3	7
Pherusa plumosa		1	0	2	2	5
Capitella capitata		30	63	53	105	251
Mediomastus californiensis		0	0	0	1	1
Ampharete arctica		0	1	0	0	1
Asabellides oculata		1	0	0	1	2
Amphitrite figulus		0	0	1	0	1
Sabellidae sp. (juvenile)		0	0	0	1	1
OLIGOCHAETA						
Tubificoides spp.		23	17	21	12	73
GASTROPODA						
Nassarius trivittatus		0	1	0	0	1
BIVALVIA						
Tellina agilis		1	0	0	0	1
Mya arenaria		0	0	1	1	2
TOTAL	35	354	283	636	1796	3069

STUDY SITE = BOSTON HARBOR MA

STATION = 11 SAMPLING DATE = 7-2-86

TAXA		REP 1	REP 2	REP 3	REP 4	SUM
NEMERTINEA						
Nemertinea		0	0	2	0	2
POLYCHAETA						
Harmothoe imbricata		1	0	0	2	3
Pholoe minuta		2	0	3	2	7
Anaitides mucosa		0	0	1	0	1
Eteone flava		25	0	55	61	141
Microphthalmus aberrans		0	0	0	1	1
Autolytus cornutus		1	0	0	1	2
Nereis virens		0	0	0	4	4
Ophryotrocha puerilis		0	0	0	1	1
Polydora caulleryi		0	0	2	7	9
Polydora quadrilobata		0	0	2	5	7
Polydora ligni		11	0	12	20	43
Polydora aggregata		15	0	60	65	140
Prionospio (P.) steenstrupi		1	0	0	2	3
Spio filicornis		0	0	40	52	92
Spio armata		3	0	12	83	98
Streblospio benedicti		1	0	2	18	21
Trochochaeta multisetosa		0	0	0	1	1
Cirratulidae sp. (fragment)		1	0	4	1	6
Cirratulus cirratus		0	0	0	1	1
Caulleriella sp.		0	0	2	6	8
Pherusa plumosa		1	0	1	2	4
Capitella capitata		153	0	41	160	354
Asabellides oculata		0	0	0	1	1
OLIGOCHAETA						
Tubificoides spp.		19	0	52	57	128
GASTROPODA						
Nassarius trivittatus		0	0	2	0	2
BIVALVIA						
Modiolus sp. (juvenile)		0	0	1	0	1
TOTAL	27	234	0	294	553	1081

STUDY SITE = BOSTON HARBOR MA

STATION = 11 SAMPLING DATE = 7-2-86

TAXA		REP 1	REP 2	REP 3	REP 4	SUM
NEMERTINEA						
Nemertinea		0	0	2	0	2
POLYCHAETA						
Harmothoe imbricata		1	0	0	2	3
Pholoe minuta		2	0	3	2	7
Anaitides mucosa		0	0	1	0	1
Eteone flava		25	0	55	61	141
Microphthalmus aberrans		0	0	0	1	1
Autolytus cornutus		1	0	0	1	2
Nereis virens		0	0	0	4	4
Ophryotrocha puerilis		0	0	0	1	1
Polydora caulleryi		0	0	2	7	9
Polydora quadrilobata		0	0	2	5	7
Polydora ligni		11	0	12	20	43
Polydora aggregata		15	0	60	65	140
Prionospio (P.) steenstrupi		1	0	0	2	3
Spio filicornis		0	0	40	52	92
Spio armata		3	0	12	83	98
Streblospio benedicti		1	0	2	18	21
Trochochaeta multisetosa		0	0	0	1	1
Cirratulidae sp. (fragment)		1	0	4	1	6
Cirratulus cirratus		0	0	0	1	1
Caulleriella sp.		0	0	2	6	8
Pherusa plumosa		1	0	1	2	4
Capitella capitata		153	0	41	160	354
Asabellides oculata		0	0	0	1	1
OLIGOCHAETA						
Tubificoides spp.		19	0	52	57	128
GASTROPODA						
Nassarius trivittatus		0	0	2	0	2
BIVALVIA						
Modiolus sp. (juvenile)		0	0	1	0	1
TOTAL	27	234	0	294	553	1081

STUDY SITE = BOSTON HARBOR MA

STATION = 12 SAMPLING DATE = 7-2-86

TAXA		REP 1	REP 2	REP 3	REP 4	SUM
POLYCHAETA						
Pholoe minuta		0	0	0	2	2
Eteone flava		0	1	2	3	6
Microphthalmus aberrans		0	1	12	12	25
Nereis virens		0	0	0	1	1
Polydora quadrilobata		0	0	0	1	1
Polydora ligni		8	2	3	5	18
Polydora aggregata		0	0	0	1	1
Spio armata		0	1	0	0	1
Streblospio benedicti		1	2	14	5	22
Caulleriella sp.		1	0	1	1	3
Capitella capitata		67	32	146	197	442
OLIGOCHAETA						
Oligochaeta		0	0	1	2	3
Tubificoides spp.		1	0	7	13	21
TOTAL	13	78	39	186	243	546

STUDY SITE = BOSTON HARBOR MA

STATION = 13 SAMPLING DATE = 7-2-86

TAXA		REP 1	REP 2	REP 3	REP 4	SUM
POLYCHAETA						
Harmothoe imbricata		0	1	0	0	1
Pholoe minuta		12	1	16	0	29
Anaitides mucosa		4	4	0	0	8
Anaitides maculata		0	2	0	0	2
Eteone flava		83	68	54	0	205
Microphthalmus aberrans		1	0	13	0	14
Autolytus cornutus		2	0	0	0	2
Nephtys caeca		1	3	0	0	4
Polydora socialis		3	2	0	0	5
Polydora caulleryi		2	2	0	0	4
Polydora quadrilobata		1	0	0	0	1
Polydora ligni		16	80	92	0	188
Polydora aggregata		524	309	21	0	854
Prionospio (P.) steenstrupi		1	1	4	0	6
Spio filicornis		9	7	1	0	17
Spio cf. limicola		0	1	0	0	1
Spio armata		16	14	33	0	63
Streblospio benedicti		8	4	13	0	25
Trochochaeta multisetosa		0	2	0	0	2
Cirratulidae sp. (fragment)		14	15	3	0	32
Caulleriella sp.		11	5	5	0	21
Pherusa plumosa		1	1	0	0	2
Capitella capitata		2	3	28	0	33
Ampharete arctica		4	2	0	0	6
Sabellidae sp. (juvenile)		1	0	0	0	1
OLIGOCHAETA						
Oligochaeta		0	0	2	0	2
Tubificoides spp.		8	11	17	0	36
CRUSTACEA						
Corophium sp. (juvenile)		1	0	0	0	1
TOTAL	28	725	538	302	0	1565

BOSTON HARBOR, MASSACHUSETTS
NOVEMBER 18-20, 1986
INDIVIDUALS/ 0.04M^2 MODIFIED VAN VEEN GRAB
500 MICRON SEIVE

Replicate	STATION 1 A	B	C	D	STATION 2 A	B	C	D
	NO ORGANISMS FOUND							
POLYCHAETA								
Spionidae								
Polydora ligni					3	-	-	-
BIVALVIA								
Modiolus modiolus (set)					-	1	-	-
CRUSTACEA								
AMPHIPODA								
Ampelisca abdita					-	-	1	-
TOTAL INDIVIDUALS	0	0	0	0	3	1	1	0
TOTAL SPECIES	0	0	0	0	1	1	1	0

Replicate	STATION 3 A	B	C	D	STATION 4 A	B	C	D
OLIGOCHAETA								
Tubificidae	-	-	-	-	-	1	-	-
POLYCHAEATA								
Nereidae								
Nereis virens	-	1	-	-	-	-	-	-
CRUSTACEA								
DECAPODA								
Pagurus acadianus	-	-	-	-	-	-	-	2
TOTAL INDIVIDUALS	0	1	0	0	0	1	0	2
TOTAL SPECIES	0	1	0	0	0	1	0	1

BOSTON HARBOR, MASSACHUSETTS
NOVEMBER 18-20, 1986
INDIVIDUALS/ 0.04M² MODIFIED VAN VEEN GRAB
500 MICRON SEIVE

Replicate	STATION 5 A	B	C	D	STATION 6 A	B	C	D
RHYNCHOCOELA	-	-	-	-	1	-	-	-
OLIGOCHAETA								
Tubificidae	9	11	18	50	1	1	-	-
POLYCHAETA								
Sigalionidae								
Pholoe minuta	-	-	-	-	2	-	-	-
Phyllodocidae								
Phyllodoce sp. (immature)	-	-	-	-	-	-	-	1
Eteone flava	-	1	1	-	-	-	-	-
Nereidae								
Nereis virens	-	-	-	-	-	1	-	-
Nephthyidae								
Nephtys sp. (immature)	1	-	-	-	6	7	1	5
Spionidae								
Polydora ligni	2	29	36	-	45	34	73	38
Polydora aggregata	-	-	-	-	-	-	-	2
Polydora sp.	-	-	-	2	-	-	-	-
Prionospio steenstrupi	-	-	-	-	1	1	2	-
Spio sp. (immature)	1	4	1	4	1	-	1	1
Streblospio benedicti	18	22	32	18	30	6	29	29
Cirratulidae								
Tharyx acutus	-	4	10	2	15	5	10	8
Capitellidae								
Capitella capitata	-	-	1	-	-	-	-	-
Mediomastus ambiseta	-	-	-	-	-	-	-	1
Syllidae								
Autolytus sp.	-	-	-	1	-	-	-	-
BIVALVIA								
Bivalvia species (shell dissolved)	-	1	-	-	-	-	-	-
Mya arenaria	-	-	2	2	1	-	1	-
Lyonsia sp. (immature)	-	-	-	-	-	-	-	1
Modiolus modiolus	-	-	-	1	-	-	-	-
GASTROPODA								
Nassarius trivittatus	-	-	-	1	56	9	18	63
CRUSTACEA								
AMPHIPODA								
Ampelisca abdita	1	-	1	-	68	5	88	203
Leptocheirus pinguis	-	-	-	-	-	-	-	1
Photis macrocoxa	-	-	-	-	5	2	11	11
Unciola irrorata	-	-	-	-	1	1	1	1
Gammarus sp.	-	-	-	-	1	-	-	-

BOSTON HARBOR, MASSACHUSETTS
NOVEMBER 18-20, 1986
INDIVIDUALS/ 0.04M² MODIFIED VAN VEEN GRAB
500 MICRON SEIVE

	STATION 5				STATION 6			
Replicate	A	B	C	D	A	B	C	D
CUMACEA								
Diastylis sculpta	-	-	-	-	-	-	-	2
Diastylis polita	-	-	-	-	1	-	-	1
Diastylis sp. (immature)	-	2	-	-	-	-	2	-
ISOPODA								
Edotea triloba	-	-	-	-	-	-	2	3
DECAPODA								
Crangon septemspinosa	-	-	-	-	-	-	-	1
TOTAL INDIVIDUALS	32	74	122	81	235	72	239	372
TOTAL SPECIES	6	8	9	9	16	11	13	18

BOSTON HARBOR, MASSACHUSETTS
NOVEMBER 18-20, 1986
INDIVIDUALS/ 0.04M² MODIFIED VAN VEEN GRAB
500 MICRON SEIVE

	STATION 7				STATION 8			
Replicate	A	B	C	D	A	B	C	D
	NO ORGANISMS FOUND							
GASTROPODA (Immature)					-	-	1	-
CRUSTACEA								
DECAPODA								
Crangon septemspinosa					-	1	-	-
TOTAL INDIVIDUALS	0	0	0	0	0	1	1	0
TOTAL SPECIES	0	0	0	0	0	1	1	0

	STATION 9				STATION 10			
Replicate	A	B	C	D	A	B	C	D
POLYCHAEATA								
Spionidae								
Streblospio benedicti	-	1	-	-	5	4	2	-
TOTAL INDIVIDUALS	0	1	0	0	5	4	2	0
TOTAL SPECIES	0	1	0	0	1	1	1	0

BOSTON HARBOR, MASSACHUSETTS
NOVEMBER 18-20, 1986
INDIVIDUALS/ 0.04M^2 MODIFIED VAN VEEN GRAB
500 MICRON SEIVE

Replicate	STATION 11 A	B	C	D	STATION 12 A	B	C	D
					NO ORGANISMS FOUND			
OLIGOCHAETA								
Tubificidae	-	-	1	1				
Peloscolex sp.	-	-	1	-				
POLYCHAETA								
Capatellidae								
Capitella capitata	-	1	-	-				
BIVALVIA								
Tellina agilis	-	-	-	1				
TOTAL INDIVIDUALS	0	1	2	2	0	0	0	0
TOTAL SPECIES	0	1	2	2	0	0	0	0

Replicate	STATION 13 A	B	C	D
OLIGOCHAETA				
Tubificidae	9	-	-	-
POLYCHAEATA				
Spionidae				
Streblospio benedicti	2	-	-	-
Cirratulidae				
Tharyx acutus	5	-	-	1
TOTAL INDIVIDUALS	16	0	0	1
TOTAL SPECIES	3	0	0	1

Boston Inner and Outer Harbors Finfish Species List

Scientific Name	Common Name
Alosa pseudoharengus	Alewife
Anguilla rostrata	American eel
Ammodytes americanus	American sandlance
Osmerus mordax	American smelt
Gadus morhua	Atlantic cod
Clupea harengus harengus	Atlantic herring
Scomber scombrus	Atlantic mackerel
Brevoortia tyrannus	Atlantic menhaden
Menidia menidia	Atlantic silverside
Microgadus tomcod	Atlantic tomcod
Lepomis macrochirus	Bluegill
Pomatomus saltatrix	Bluefish
Alosa aestivalis	Blueback herring
Peprilus triacanthus	Butterfish
Cyprinus carpio	Carp
Tautoolabrus adspersus	Cunner
Brosme brosme	Cusk
Apeltes quadracus	Fourspine stickleback
Myoxocephalus aenus	Grubby
Urophycis sp.	Hake
Raja erinacea	Little skate
Myoxocephalus octodecemspinosus	Longhorn sculpin
Cyclopterus lumpus	Lumpfish
Fundulus heteroclitus	Mummichog
Pungitius pungitius	Ninespine stickleback
Syngnathus fuscus	Northern pipefish
Macrozoarces americanus	Ocean pout
Pollachius virens	Pollock
Osmerus mordax	Rainbow smelt
Esox americanus americanus	Red fin pickerel
Urophycis chuss	Red hake
Liparis atlanticus	Sea snail
Hemitripterus americanus	Sea raven
Prionotus sp.	Sea robin
Myoxocephalus sp.	Sculpin

Boston Inner and Outer Harbors Finfish Species List

Scientific Name	Common Name
Merluccius bilinearis	Silver hake
Liopsetta putnami	Smooth flounder
Squalus acanthias	Spiny dogfish
Anchoa hepsetus	Striped anchovy
Morone saxatilis	Striped bass
Fundulus magalis	Striped Killifish
Gasterosteus aculeatus	Threespine stickleback
Cynoscion regalis	Weakfish
Scophthalmus aquosus	Windowpane
Morone americanus	White perch
Merluccius merluccius	Whiting
Pseudopleuronectes americanus	Winter flounder
Raja ocellata	Winter skate
Limanda ferruginea	Yellowtail flounder

APPENDIX IV

COORDINATION

Coordination Letters Received

Agency	Date	Comments
I. U.S. Fish and Wildlife Service	25 August 1987	Planning Aid Letter 1. Resource information 2. Anadromous fisheries 3. Turbidity 4. Disposal Suitability
II. Massachusetts Executive Office of Environmental Affairs/Coastal Zone Management	22 March 1988	1. Disposal Suitability 2. Economic Justification
III. Massachusetts Division of Marine Fisheries	25 March 1988	1. Does not oppose the project. 2. Avoid anadromous fisheries 3. Evaluate dredged material to be disposed
IV. New England Aquarium (Conservation Coordinator)	25 March 1988	1. Impacts require EIS 2. High levels of contaminants 3. Dredging impacts 4. Need for Bioassay Studies 5. Disposal Suitability
V. National Marine Fisheries Service	5 April 1988	1. "do not object" 2. Disposal suitability 3. Endangered species (disposal site) impacts need further assessment

VI. Massachusetts Historical Commission	19 April 1988	1. No adverse effect
VII. Boston Redevelopment Authority	27 April 1988	1. Support project 2. Disposal suitability sediment contamination
VIII. U.S. Environmental Protection Agency	28 April 1988	1. Agree with postponing testing to post authorization 2. Disposal Suitability/ sediment contamination

Note: The U.S. Fish and Wildlife Service coordination report was unable to be completed at this time because of a manpower shortage at the service. With the arrival of new personnel, the report will be completed and forwarded to New England Division in late summer 1988.

Coordination Issues

A. Disposal Suitability and Sediment Contamination (Letters I, II, III, IV, V, VII, VIII))

The impacts associated with dredged material disposal will be evaluated by conducting additional sediment chemistry, bioassay and bioaccumulation testing prior to construction. The results of this testing will be coordinated with all pertinent agencies.

B. Anadromous Fisheries (Letters I and III)

The project has been designed to mitigate anadromous fisheries impacts by avoiding migration runs.

C. Economic Justification (Letter II)

Economic analyses have been updated.

D. Dredging Impacts (Letter I and IV)

The prediction of limited spatial and temporal impacts of dredging are based on the cited literature and tidal prism volumes in Boston Harbor. In addition, benthic studies in Boston Harbor indicate annual defaunation due to anoxia, indicating settling of resuspended contaminants in the channel areas will impart limited impacts on biota.

E. Endangered Species Impacts (Letter V)

The impacts of dredged material disposal at the Foul Area Disposal Site on endangered species of whales (and their prey) will be fully evaluated after bioassay/bioaccumulation testing is performed. These tests results will be coordinated with NMFS Endangered Species Coordinator to assure full compliance with Section 7 of the Endangered Species Act.

F. Need for EIS (Letter IV)

The deepening of sections of existing channels in Boston Harbor and the limited environmental perturbations of this urban area do not impart a significant impact on the human environment requiring an EIS (see FONSI).

April 19, 1988

Thomas Rhen
Division Engineer
Army Corps of Engineers
424 Trapelo Rd.
Waltham, MA 02254-9149

RE: Deep-Draft Navigation Improvements to Boston Harbor, Draft Environmental Assessment, Boston and Chelsea

Dear Colonel Rhen:

Thank you for submitting a copy of the report referenced above to the Massachusetts Historical Commission. Staff of the MHC have reviewed the draft feasibility study and environmental assessment.

The project includes the Chelsea Street Bridge, which is considered to be eligible for listing in the National Register of Historic Places as the only surviving Strauss heel-trunnion bascule bridge in Massachusetts. Your proposal includes the replacement of the bridge's fender system to increase the existing 96-foot horizontal clearance to 100 feet. The MHC anticipates that your proposal will have no adverse effect (36 CFR 800.9) on the significant historic and engineering characteristics of the bridge, provided that the MHC is given the opportunity to review project design plans for the proposed bridge work.

These comments have been offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966 (36 CFR 800). A copy of this letter should be included with the documentation you submit to the Advisory Council on Historic Preservation, Old Post Office Building, 1100 Pennsylvania Ave., NW, #809, Washington, D.C. 20004.

If you have any questions concerning these comments, please feel free to contact Brona Simon or William Smith at this office.

Sincerely,

Valerie A. Talmage

Valerie A. Talmage
Executive Director
State Historic Preservation Officer
Massachusetts Historical Commission

xc: ACHP
Marie Bourassa, ACE

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Habitat Conservation Branch
Sandy Hook Marine Laboratory
Highland, NJ 07732

April 5, 1988

Colonel Thomas A. Rhen
Division Engineer
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Col. Rhen:

We have reviewed the Draft Feasibility Report and Environmental Assessment (Report) for navigation improvements to Boston Harbor, Massachusetts. The proposed structural improvements involve deepening the Federal Channels in the Reserved Channel, the lower Mystic River, and the Chelsea River from 35 to 40 feet deep at mean low water, and disposing of approximately 2.4 million cubic yards of dredged material at the Foul Area Disposal Site (FADS) in Massachusetts Bay.

We do not object to the proposed dredging, but we are concerned with the proposed disposal of all of the dredged material at the FADS. About 80% of the dredged material consists of lean clay and rock, and should be acceptable for ocean disposal. However, previous dredging projects in Boston Harbor, as well as other published information regarding the quality of Boston Harbor sediments, show that some of the surficial dredged material will be unsuitable for ocean disposal. This Report indicates that the adverse effects of disposing the project's polluted sediments will be mitigated by capping with the cleaner dredged material. However, we have seen no information to indicate that capping is an effective management technique for sequestering contaminated sediments at the FADS. Unless the capping issue at FADS can be resolved prior to this dredging project, we recommend that the Corps investigate other disposal options for the 20% of the dredged material likely to be contaminated.

Endangered and threatened species that may occur in the disposal site area include the humpback whale, Megaptera novaeangliae, right whale, Eubalaena glacialis, fin whale, Balaenoptera physalus, sei whale, Balaenoptera borealis, leatherback turtle, Dermochelys coriacea, and loggerhead turtle, Caretta caretta. The impacts of disposal at FADS on endangered and threatened species are currently being assessed in the ongoing FADS site designation process. We cannot, at this time, concur with the Report's assumption that endangered and threatened species and their food sources will not be affected by disposal activities at FADS.

For further coordination regarding this project, please contact Susan Mello at (617) 548-5123 or Doug Beach at (617) 281-3600.

Sincerely,

Stanley W. Gorski
Assistant Branch Chief

New England Aquarium

Central Wharf
Boston, Massachusetts 02110-3399
(617) 973-5200

March 25, 1988

Thomas A. Rhen
Colonel, Corps of Engineers
Division Engineer, New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Colonel Rhen,

Enclosed are comments prepared by the New England Aquarium regarding the Boston Harbor Navigation Improvement Study, Draft Feasibility Report and Environmental Assessment.

Thank you for the opportunity to comment. If you have any questions about the points we raise, please feel free to call me at (617) 973-6552.

Sincerely,

Sharon Dean

Sharon Dean
Conservation Coordinator
New England Aquarium

SED
Enclosure

New England Aquarium

NEW ENGLAND AQUARIUM

COMMENTS

Submitted to

The U.S. Army Corps of Engineers
New England Division

re:

NAVIGATION IMPROVEMENT STUDY
FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT
MYSTIC RIVER, CHELSEA RIVER AND RESERVED CHANNEL
Boston Harbor, Massachusetts

March 25, 1988

The New England Aquarium has reviewed the U.S. Army Corps of Engineers Draft Navigation and Improvement Study/Feasibility Report and Environmental Assessment for the Mystic River, Chelsea River and Reserved Channel, Boston Harbor, Massachusetts. We have several concerns regarding potential environmental impacts of the proposed project. We believe the Corps' "Finding of No Significant Impact" and determination that a full Environmental Impact Study should not be required, is unjustified. Contaminant data contained in the Environmental Assessment, and data gathered from other assessments made on sediments adjacent to or within the proposed dredge sites, indicate that these areas contain high levels of toxic compounds. A full Environmental Impact Study should therefore be required.

The proposed project would entail dredging approximately 2.3 million cubic yards of silt, clay and sand, plus an additional 90,000 cubic yards of fragmented ledge, and the disposal of these spoils at the Massachusetts Bay Foul Area Disposal Site (FADS).

The New England Aquarium's Edgerton Research Laboratory has conducted numerous studies in which Boston Harbor sediments have been analysed for both metal and organic contaminants. Two of these studies have a direct bearing on the Corps of Engineers' proposed dredging project. In an early work (New England Aquarium, 1972, Trace Metal Analysis of Boston Harbor Water and Sediments, Vol. II), exceptionally high concentrations of such metals as cadmium (3.3 to 10 ppm), copper (226 to 357 ppm), mercury (0.9 to 2.3 ppm) and lead (161 to 675 ppm) were measured in sediments from three stations in the Mystic River. In a more

recent study (New England Aquarium, 1982, Chemical Evaluation of Sediments from a Proposed Marina on Reserved Channel, South Boston, Massachusetts), high levels (Class III) of arsenic (24 to 34 ppm), nickel (679 ppm), mercury (1.7 to 10.8 ppm), lead (247 to 1176 ppm), and PCBs (1 to 34.5 ppm) were measured in one or several of the 13 sites sampled in the upper reaches of Reserved Channel (west of the Summer St. Bridge).

The contaminant concentrations reported in these two New England Aquarium studies are, in general, considerably higher than the concentrations reported in the Environmental Assessment portion of the Corps of Engineers' draft document (pp. EA-15 to EA-23; EA-I-2 to EA-I-9). Additional testing should therefore be conducted by the Corps of Engineers to determine whether sediments are in fact more contaminated than the draft document would imply.

Regardless of the precise levels of contamination, it is clear that these sediments are substantially contaminated, primarily with heavy metals and PCBs. This raises questions concerning the effects that the dredging will have on the resuspension of sediments, the degree to which metals and PCBs will be mobilized, the bioavailability of these metals and PCBs, and the resulting toxicity to critical life stages of commercially important finfish and shellfish, as well as the toxicity to benthic invertebrates. Bucket dredging, in contrast to more easily controlled suction dredging, may compound the problem of resuspension and bioavailability of toxics.

The Draft Environmental Assessment (p. EA-58) states that the main environmental impacts that will be caused by the dredging are:

1) removal of benthic organisms and the short-term loss of benthic productivity;

2) masking of chemical signals essential for anadromous fish migrations; and

3) reduction in photosynthesis and associated primary productivity due to periods of high turbidity.

The Corps has concluded that all three of these impacts will be short-term and will only effect small local areas. Yet, no assessment has been made of the toxicity of the resuspended sediments to larval or juvenile stages of fish and shellfish, phytoplankton, zooplankton, or benthic invertebrates. Informa-

V

tion is lacking on spawning species, larval contribution to recruitment of fish, and on the importance of the dredge areas as feeding habitat for fish.

The Draft Environmental Assessment further states that there will be a minimal release of metals and pesticides into solution during dredging (p. EA-57). This conclusion is based on two studies disseminated as technical reports by the Corps of Engineers (Chen et al., 1976; Bulk et al, 1975). However, it is generally recognized that the speciation of metals in marine waters, especially in the pore waters of harbor sediments, is complex. In addition, the well-known association of PCBs and suspended particulates, and the rapid accumulation of particle-associated PCBs by marine organisms, suggest that the resuspension of harbor sediments during dredging may be a significant toxicological problem. In fact, the reported results of the elutriate analysis of the Reserved Channel, Mystic River and Chelsea River sediments (pp. EA-59 to EA-60) indicate that high concentrations of PCBs will be released during dredging, as well as significant quantities of metals, oil and grease.

Questions surrounding environmental impact of the dredging must be resolved. Bioassay, contaminant bioburden and metal speciation studies should be conducted in order to address this issue. We recommend such studies be made part of a detailed Environmental Impact Study on the proposed dredging project.

The Draft Environmental Assessment also concludes that the dredged material is "suitable" for disposal at the Massachusetts Bay Foul Area Disposal Site (FADS), although the report recognizes that further testing (bioassays and bioaccumulation studies) will be necessary to substantiate this assumption. While the disposal of the material at the FADS will probably be of less environmental impact than the actual dredging, the sheer magnitude of the amount of dredge spoils that will be disposed of is of concern.

The Draft Environmental Assessment states that approximately 3 million cubic yards of dredge material were deposited at the FADS between 1975 and 1986 (p. 84). The proposed addition of 2.3 million cubic yards of contaminated dredge spoils over a two-year period reinforces the need for conducting proper bioassays and contaminant bioburden studies.

Precisely what will be the fate and effects of the dredge spoils on the FADS? Will capping be effective in containing the dredge material? Might it be redistributed to other parts of

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Massachusetts Bay? These very important questions should be addressed.

In summary, the New England Aquarium believes the Draft Environmental Assessment does not sufficiently evaluate the possible toxic effects of sediments that will be resuspended during the two years of dredging, or the effects of disposal of dredged material at the Mass. Bay Foul Area Disposal Site. Bioassay, bioaccumulation and metal speciation studies should be begun as soon as possible. As well, more detailed analysis of physical and oceanographic processes operating at the Foul Area Disposal Site, and investigation into whether any capping of contaminated sediments would be effective, should be conducted. At the very least, we recommend that these studies be incorporated into the "Scope of Work" for a full Environmental Impact Study on the proposed dredging project.

The Environmental Protection Agency is presently completing the "Scope of Work" for an Environmental Impact Study on the proposed official designation of the FADS as an open water ocean disposal site for Boston Harbor sediments. In addition, the Mass. Office of Coastal Zone Management is proposing that a Generic Environmental Impact Report (GEIR) be done on the question of official designation. The GEIR would address the question of dredging need, the quantities of material to be dredged and disposed, the quality of the material, dredging methods, and alternative disposal sites. The Corps of Engineers' proposal to dredge the Chelsea River, Mystic River and Reserved Channel, and to dispose of the highly contaminated sediments at the FADS -- prior to completion of these comprehensive studies -- is premature. Dredging should be contingent upon the results of these studies.

Thank you for consideration of these comments.

Sharon Dean
Conservation Coordinator

William Robinson, PhD
Senior Scientist

New England Aquarium

SED/WR
cc: John Prescott, Executive Director, New England Aquarium
Paul Boyle, Director of Programs and Exhibits/General Curator, New England Aquarium

United States Department of the Interior

FISH AND WILDLIFE SERVICE
400 RALPH PILL MARKETPLACE
22 BRIDGE STREET
CONCORD, NEW HAMPSHIRE 03301-4901

Joseph Ignazio, Chief
Planning Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Ignazio:

This Planning Aid Letter has been prepared to assist you in the preparation of the draft feasibility report regarding the proposed deep-draft navigation improvement project in Boston Harbor.

The proposed project is designed to deepen a portion of the 35-foot section of the Inner Harbor-Main Ship Channel to 40 feet, which would provide a 40 foot channel wider than the existing 600 feet. The Reserved Channel would be deepened to 40 feet with the development of a small 40 foot deep turning area at the confluence of the Reserved and Main Ship Channels. Moreover, the existing 35-foot Mystic and Chelsea River channels would be dredged to a 40 foot depth. Approximately 2 million cubic yards of rock, silt and silty sand material from this project would be disposed at the Foul Area Disposal Site. If approved and constructed, the project would improve the navigation of deep draft ships in Boston Harbor.

Both the Inner and Outer Harbors support a diversity of finfish and shellfish resources. The greatest concentration and diversity of finfish occurs in the Outer Harbor, although many species can be found in the Inner Harbor as well. Although the water quality in portions of Boston Harbor does not meet national goal uses due to industrial and domestic pollution, finfish provide a recreational sport fishery for many people. Menhaden, winter flounder, ocean pout, cod, bluefish, pollack and striped bass can be expected to occur in Boston Harbor. The Boston Harbor area also supports numerous anadromous fish runs. Shad, alewife, smelt and blueback herring enter, or attempt to ascend, most of the streams and rivers flowing into Boston Harbor. Turbidity and sedimentation may impact anadromous fishes if the work is conducted in the Inner Harbor during the spring. Fish are moving into the mouths of streams and rivers during the spring-summer months prior to their annual spawning run. Rivers supporting anadromous fish runs should not be dredged from June to September 30.

There are numerous intertidal flats in both the Inner and Outer Harbors that support soft shell clams, and other important invertebrates. Most of the flats are located in Hingham and Dorchester Bays, although it is of interest to note that there are some flats along the northern side of Logan Airport. Your feasibility report should identify these flats and address ways to avoid impacting these resources. An issue that needs to be addressed is how

increased turbidity and sedimentation from the dredging operation may affect soft shell clams and other mollusks. This is particularly important if the sediment is suspended for long periods of the time and carried by currents to the flats. We are concerned that sustained additional sedimentation above the normal levels in the harbor could adversely impact mollusks by hindering their respiratory and feeding mechanism. The distance between these flats and the dredging sites does reduce the likelihood of impacts to the shellfish but we believe that this potential impact should be addressed.

Severe turbidity might also impact commercial lobster pounds along the Boston waterfront since their intake pipes remove water from the Inner Harbor. When the Harbor is turbid, such as during severe storms, sediments have caused significant losses in lobster tanks. This possible impact should also be addressed.

According to your estimates, approximately 2 million cubic yards of rock, silt and silty sand material will be disposed of at the Foul Area. It seems premature to identify the Foul Area as the disposal site for all dredge material without having conducted the necessary bioassay/bioaccumulation studies. We reviewed contaminant levels in eleven Boston Harbor projects involving dredging in the past 10 years (Table 1). Nearly all of the contaminants measured in the Boston Harbor Federal navigation channel exceed the New England River Basin Commission's Category II criteria. Other projects in the Harbor involving dredging contain many contaminants which also exceed the Category II criteria. This Class III material is too contaminated to be considered for open water disposal since there is no reasonable way in which this material can be capped in 300 feet of water.

Biological testing was conducted in three of the projects and all demonstrated significant bioaccumulation of contaminants using "Green Book" criteria. Since testing procedures frequently underestimate bioaccumulation, sediments yielding statistically significant amounts of bioaccumulation are particularly onerous.

Another example of the grossly contaminated sediments found in the proposed project area is found in the research of Shiaris and Jambard-Sweet as reported in Marine Pollution Bulletin 17(10): 469-472. The report indicates very high total PAH levels in the Boston Inner Harbor, with mean total sediment PAHs ranging from 10 parts per million at the mouth of the Reserved Channel to 718 parts per million in the Fort Point Channel. The highly toxic and carcinogenic nature of PAH as a group of compounds, coupled with their relative persistence, makes open water disposal of these materials unwise.

One last point regarding the nature of sediments in the project area relates to the scope of testing. As you know, bulk sediment analyses address only nine metals, PCB's, oil and grease, "petroleum hydrocarbons," and occasionally

DDT. There are many other hazardous contaminants in the Harbor that are not included in contaminant analyses summaries because they are not tested. For instance, the focus of the Shiaris and Jambard-Sweet Study was PAHs, which were found in significant levels in the project area. The EPA lists 129 priority pollutants that are considered potential threats to living organisms. Many of these are likely found in the project area, although their presence is unconfirmed due to the lack of specific analyses. If disposal options other than containment are anticipated for project sediments, we recommend expanding bulk sediment analyses to include at least the 129 priority pollutants, and possibly some of the so-called non-conventional pollutants.

Furthermore, since Corps policy is to use the material in the most beneficial manner, the ledge/rock material should not be disposed of at the Foul Area. Rather, it should be used to create an artificial fishing reef for lobsters and finfish. Your feasibility study needs to explore the use of dredged material as a means of creating habitat. This would also provide recreation for sport fishermen. Indeed, any material not contaminated should be considered for use in a beneficial manner.

We trust these comments are helpful and we look forward to continued coordination with your staff.

Sincerely yours,

for Gordon E. Beckett
Supervisor
New England Area

TABLE 1. HIGHEST REPORTED LEVELS OF CONTAMINANTS AT VARIOUS SITES IN BOSTON HARBOR

Project	Hg	Pb	Zn	As	Cd	Cr	Cu	Ni	V	PCB	PHC	%O&G
Boston Edison, Res. Chnl	11**	63	105	55**	1.7	77	68	35	57	720		4.4
City of Boston Boston Hbr. Dredge	.28	627**			11**	163*	309*			10,000**		1.82
Jeffries Pt. Yacht Club Boston Harbor	<1	37	83	15*	.9	40	27	26	38			
Blue Circle Atlantic Mystic River, Mass.	1.5*	290**	440**	31**	4.5*	200*	240*	38		2,800**		4.3
Fan Pier Boston Harbor	<.08	294**	378*	58**	5.6*	270*	294*	42		13,400**		3500ppb
North Jetty Boston Harbor	3.2**	354**	333*	33**	5*	248*	237*	39	70	480		.9
Northeast Petrol. Chelsea River	1.1*	230**	410**	21**	3.7*	480**	180	26	135**	720		6.37
Boston Edison Mystic River	2.1**	55	49	14*	2.0	35	63	170**	ND	ND		
Dredging Island End River	1.06*	390**	449**	42**	11**	110*	239*	75*				
COE 1972 Fed. Nav. Channel	1.76**	421**	533**	41**	7.6**	490**	787**	56*	329**			20.1
COE 1975 Fed. Nav. Channel	2.29**	361**	667**	24**	10**	1120**	336*	193**	257**			17.81

* Exceeds NERBC Category I

** Exceeds NERBC Category II

The Commonwealth of Massachusetts
Division of Marine Fisheries
Leverett Saltonstall State Office Building
100 Cambridge Street
Boston, Massachusetts 02202
727-3193

PHILIP G. COATES
DIRECTOR

March 25, 1988

Col. Thomas A. Rhen
Division Engineer
New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Col. Rhen:

The Division has reviewed the draft Fessibility Report and Environmental Study for the modification of the existing Federal navigation projects in Boston Harbor, Massachusetts. The Division does not oppose the project, however, there are two major concerns relating to fishery impacts.

First we request that dredging be conducted so as not to impede or otherwise prevent anadromous fish including smelt, American shad and alewives from migrating to and from the Charles and Mystic Rivers on annual spawning runs. Secondly, we are concerned that certain toxics, namely PCBs and PAHs be sufficiently sampled in each of the proposed dredging areas to provide a representative characterization of the dredge spoils since sediments may contain excess amounts of these hydrocarbons so as to preclude disposal in the foul area disposal site.

In the event that toxics exceed EPA and state criteria for ocean disposal, alternatives must be included in the final report. The Division is also concerned that PAH levels may be sufficiently elevated in sediments at some locations to present problems with resuspension and bioaccumulation during and after both dredging and disposal relative to the fishery resources, particularly the lobster and winter flounder populations.

Sincerely yours,

W. Leigh Bridges (emg)
W. Leigh Bridges
Assistant Director

cc: Judy Pederson, CZM
R. Fairbanks, DMF

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

COASTAL ZONE
MANAGEMENT

March 22, 1988

Col. Thomas A. Rhen
Division Engineer
New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254-9149

RE: Modifications to the Boston Harbor Federal Navigation Project

Dear Col. Rhen:

Governor Dukakis has asked that we provide comment to you regarding the proposed modifications to the Federal navigation project in Boston Harbor as described in the Feasibility Report and Environmental Assessment (FR/EA) dated February, 1988. As we recognize that this process will continue for a number of years and that the New England Division (NED) will, over that time, be actively seeking to coordinate their efforts, regarding this project, with the various relevant agencies of the Commonwealth, we will restrict the scope of our comments to general concerns and issues.

The two major areas of concern we have identified relate to the disposal of the dredged material that will be generated by the project and the project's economic justification. The basic assumption with regard to the disposal of the dredged material is that it will be suitable for disposal at the Foul Area Disposal Site. While we understand that the NED intends to collect this information over the next few years, and that it has available funds to initiate this work, we are concerned that other disposal options appear to have been eliminated from consideration. We feel that this decision is unjustified, especially in light of the additional information on the disposal of sediments from Boston Harbor that is currently being generated by the consultants for the Massachusetts DPW in support of the construction of the Third Harbor Tunnel. Should any portion of the material be shown to be unsuitable for ocean disposal, once the appropriate testing has been completed, the character of the project could be significantly altered. Given that the scaled-down version of the project includes some of the most contaminated areas in Boston Harbor, especially portions of the Mystic River, the potential exists for at least some of the dredged material to be found to be too contaminated for unconfined ocean disposal. In addition, while there has been some

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indication that the most contaminated sediments to be dredged, may be capped, we have yet to be provided with any clear indication that capping can be effective at the Foul Area. In this light, it would seem that the NED should take a greater interest in examining other disposal options, including more active participation in the the ongoing efforts to identify an appropriate location for a confined disposal facility for contaminated dredged material in Boston Harbor, as a part of the subsequent planning for this project.

Our other major area of concern is the economic justification for the project. Given the length of time that has elapsed since the development of the document, the economic analysis seems to be somewhat out of date. For example, the petroleum products shipment projections that were formulated by a consultant to the Corps in 1977 are based on a number of basic assumptions, at least two that we have identified, which have not come to pass. In this instance, we wonder whether the projections are still valid despite the violation of the assumptions. Given the rapidly changing environmental and economic conditions in Boston Harbor, the justification for the project bears much closer scrutiny. Those changes should be accounted for in subsequent planning for this project.

We look forward to working with you to resolve the outstanding issues. Thank you for providing us with the opportunity to comment on this document.

Sincerely,

Richard F. Delaney
Director

RFD/BWB
cc: Charles Natale, DEQE/DWWR
Judy Perry, DEQE/DWPC
David Davis, Massport
Gordon Beckett, USFWS
Tom Bigford, NMFS
Philip Coates, DMF

BOSTON
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Division Engineer
New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254-9149

Re: Boston Harbor Navigation Improvement Study
Feasibility Report and Environmental Assessment

Dear Sir:

The Boston Redevelopment Authority has reviewed the Feasibility Report and Environmental Assessment for the Boston Harbor Navigation Improvement Study and wishes to offer the following comments.

The proposed project consists of the deepening of the existing 35-foot deep Boston Harbor Federal channels in the Mystic River, Chelsea River, and the Reserved Channel and vicinity and in the Inner Confluence Area to 40 feet, the nonstructural realignment of the Federal Channel through President Roads, and the enlargement of the President Roads Anchorage from 350 to 420 acres. Approximately 2.4 million cubic yards of dredged material is proposed to be disposed at the Foul Area Disposal Site. Underwater blasting would be required to remove approximately 94,000 cubic yards of ledge. The purpose of the proposed project is to increase the navigational efficiency and safety of harbor operations and to reduce or eliminate tidal delays for larger vessels which are now more frequently in service. Implementation of the project would result in substantial economic benefits to the Port of Boston.

Without the improvement project, effective and efficient utilization of Boston Harbor is predicted to be reduced, causing shippers to consider other, more costly, shipping methods than presently used, such as increased use of lightering, or to avoid the port altogether. Growth and development of the port would be hampered. In addition, the anticipated future use of the harbor by vessels larger than those presently in use could increase the risk of a navigation accident. Such reduction in safety could result in significant adverse environmental impacts, including the potential for accidental oil spills since petroleum products are the primary commodities shipped through Boston.

According to the Environmental Assessment, the major

environmental impacts associated with this project include a potential for interference with anadromous fisheries migration, the removal of benthic infauna, resuspension of sediments, the release of contaminants, and burial during disposal. Proposed mitigation measures to minimize these impacts include a seasonal restriction for dredging in the various channels, the use of excavated rock for habitat creation, and sequential dredging/disposal to cap contaminants at the point of disposal. Based on an evaluation of these impacts, the Corps has concluded that the proposed project would not result in any significant adverse impacts requiring the preparation of an Environmental Impact Statement.

In our review of the report and the environmental assessment, we believe that the potential environmental impacts of the proposed navigational improvement project on water quality and marine resources have been adequately identified, are similar to the impacts resulting from previous dredging projects, and can be minimized through the implementation of the proposed mitigation measures. It is essential that the channel dredging be restricted to those months which would avoid adverse impact on the anadromous fisheries migration through the project area and that blasting, where required, occur only at those times of minimal finfish movements to minimize fish mortalities to the greatest extent feasible.

It is recognized, however, that much of the surficial sediment that would be dredged is polluted with elevated levels of PCBs and heavy metals and may be contaminated with other toxicants as well. Moreover, the acceptability of the material for disposal at the Foul Area Disposal Site has not yet been determined, since specific testing for bioassay/bioaccumulation of the dredged material contaminants has yet to be performed. Since existing sediment samples indicate that the material to be dredged often is Class III material, it may be too contaminated to be considered for open water disposal, even with the implementation of the proposed mitigation measures. Additional testing is necessary before a final decision can be made, and the results of the bioassay and bioaccumulation tests should be made available to the appropriate State regulatory agencies for review prior to this decision. To reduce the potential for detrimental impact on the biota of the Foul Area, upland disposal of the surficial sediments should be seriously considered. It is also recommended that sealed clamshell buckets be used for the dredging itself, in order to minimize the potential for turbidity generation, which can be quite high with this type of dredging.

Lacking from the environmental assessment is a schedule for the proposed work. During the next decade, considerable activity will be occurring in and around the Boston Harbor, the major projects being the Third Harbor Tunnel/Central Artery project and the construction of secondary treatment facilities at Deer Island. Both of these projects involve the construction of tunnels underneath the main shipping channel in the Inner Harbor.

The disposal of the excavate and dredged material from these and other harbor projects, estimated to total some 17.6 million cubic yards, at the Foul Area and possibly Spectacle Island will generate an extremely high volume of barge trips on the Inner and Outer Harbors. The Third Harbor Tunnel/Central Artery project is estimated to generate a maximum of 12 barge movements per day in the early 1990's, while the Deer Island treatment plant construction will generate an additional daily maximum of 18-20 barge and supply ship movements for materials transport and excavate removal. Added to this would be the estimated 1,500 barge trips generated by this navigation improvement project over a two-year period. These trips, together with the general harbor traffic and growing water transportation ferries and the substantial recreational boating that occurs during the summer months, could result in potential conflicts among this heavy traffic as well as the tunnel construction activities themselves. Therefore, it is essential that there be close coordination with the Massachusetts Water Resources Authority, the Massachusetts Department of Public Works, and the City of Boston to assure that any potential conflicts are avoided to the extent possible.

The environmental assessment indicates that excavated rock would be disposed in such a way as to create an artificial reef to increase habitat niches. It should be noted that rock fill for containment will be required for the Third Harbor Tunnel/Central Artery project. Should the schedule for the two projects allow, the reuse for the excavated rock for the Third Harbor Tunnel containment needs should be explored and may result in some beneficial economies.

Sincerely,

Paul Reavis
Assistant Director for
Engineering and Design Services

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203-2211

April 28, 1988

Colonel Thomas A. Rhen
Division Engineer
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

ATTN: Planning Divisions, Coastal Development Branch

Dear Colonel Rhen:

Thank you for providing for our review the Draft Feasibility Report and Environmental Assessment for the proposed modification of the existing navigation facilities in Boston Harbor, Massachusetts. This three inch report titled "Navigation Improvement Study, Feasibility Report and Environmental Assessment, Mystic River, Chelsea River and Reserved Channel" dated February 1988 undoubtedly contains a lot of important information concerning the proposed project and it's potential impacts.

Regrettably, we did not have sufficient staff to review the document in detail within the comment period. We have been briefed by your staff and agree with your proposed plan to do the required biological testing after the project is authorized. The following comments are provided for your information and consideration.

It is not possible to make a preliminary determination on the acceptability of the sediments for ocean disposal at the Foul Area Disposal Site at this time since we do not have the biological test results. Potential concerns are described below.

We understand the project involves a total of approximately 2.4 million cubic yards of dredging which would take approximately two years to complete if dredging and disposal occurred year round. This, however, may not be possible due to the potential need to apply time of year restrictions on the dredging activity to prevent adverse impacts to winter flounder and shellfish spawning.

Approximately 80% of the sediments are thought to be pristine blue clay and rock which would not contain elevated levels of contaminants. At least a portion of the remaining sediments, however, contain elevated levels of contaminants. Dredging and disposal of the fine grained sediments existing in the navigation

channels may present an environmental problem due to elevated levels of contaminants. We understand the Mystic River sediments sampled contain 3.0 ppm of PCB. It is likely, based on our past biological testing information, that sediments containing this level of PCB would cause a statistically significant accumulation in test organisms exposed to these sediments in a bioaccumulation test.

It is possible, therefore, that the proposed disposal at the Foul Area Disposal Site may not comply with the requirements of the Ocean Dumping Act and the London Ocean Dumping Convention. While it may be possible to manage sediment dredging and disposal to effectively isolate contaminates from biological availability, we are not convinced that this management strategy would work at the Foul Area Disposal Site (FADS) due to it's great depth. We will be evaluating this issue further in our upcoming Environmental Impact Statement on FADS designation. In addition, we are concerned that a portion of the fine grained sediments which contain the contaminants, would be suspended in the water column for long periods of time. This suspension of contaminants could increase the contaminant load of PCB's and probably an assortment of other contaminants such as PAH's in the water column and ultimately the marine sediments in a large area surrounding the disposal site.

We have also noted that according to page EA-16, the Chelsea River sediments contain 240 ppm of PCB. Unless this is a typo and was meant to be 240 ppb of PCB, the sediments would be considered to be a hazardous waste subject to regulation under the Toxic Substances Control Act (TSCA.) We suggest you check your data and correct this if necessary. Ocean Disposal would definitely not be permitted if the levels of PCB exceed 50 ppm.

We are also aware that sediments in the Reserved Channel upstream of the proposed dredging have been found to contain levels of PCB that exceed 50 ppm. Additional sediment sampling in the Reserved Channel may be needed to confirm that the "hot spot" of PCB has not moved downstream into the proposed dredge area.

We apologize that we are not able to provide additional comments or a detailed review of the document at this time due to the short review period and our lack of staff. If you have any questions and for further coordination please call Edward Reiner of my staff at (617) 565-4434.

Sincerely,

for David A. Fierra, Director
Water Management Division

cc: Gary Clayton, MA DEQE, DWWR, Boston, MA
Judy Perry, MA DEQE, DWPC, Boston, MA
Ken Carr, USFWS, Concord, NH
Chris Mantzaris, NMFS, Gloucester, MA
Sue Mello, NMFS, Woods Hole, MA
Michael Ludwig, NMFS, Milford, CT
Jim O'Connell, CZM, Boston, MA
Mark Habel, NEDACE, Coastal Development Branch, Waltham, MA

APPENDIX V

ENVIRONMENTAL ASSESSMENT

The U.S. Fish and Wildlife Service provided NED with the attached Coordination Act Report on 11 May 1988. In their closing remarks they request further coordination (i.e. this is not a Final Coordination Act Report). Upon completion of the final bioassay/bioaccumulation testing for the project, the results and predicted disposal impacts will be coordinated with the Service.

As with other reviewers (see EA-Appendix IV) the Service is concerned with secondary development, disposal impacts and dredging resuspension of sediments with contaminants.

The impacts at the disposal site, as discussed in the EA, will be predicted by post-authorization testing (bioassay/bioaccumulation) of the material to be dredged. The ability of the disposal site to contain the silt/clay material is also presented in the discussion of the low current velocities (approximately 4-5 cm/sec) in the deepwater (100 meter) basin in which the site is located. The Foul Area Disposal Site (FADS) is a natural settling basin for fine grained particulates (Gilbert, 1976) as evidenced by the fine grained nature of the ambient (unimpacted by disposal) sediments.

Cumulative impacts from disposal of various dredged material at FADS is currently being addressed in a Corps Disposal Site Technical Evaluation Document and an EPA (voluntary) EIS. Given the deepwater and 2 nautical mile diameter size of the site, FADS capacity is virtually unlimited. The site is not currently designated for construction excavate, however, so future predictions of cumulative impacts from other projects in planning stages is nebulous. The EA explains our contention that the use of a containment island may not be necessary, given the ability of NED to cap the contaminated material (approximately 15% of the total 2.4 million cubic yards) with clean, uncontaminated clay (approximately 85% of total).

The concern of the Service for anoxia episodes in the herbor is justified. The NED sampling identified this problem in its sampling and discussed the causitive factor as the organic load from wastewater treatment. Dredging of predominantly lean clay will not aggravate this condition.

The Service is concerned with potential secondary development as an indirect result of an increased channel depth. The improvement dredging will not induce secondary development, it will simply increase navigation efficiency.

In summary, no new significant issues have been raised by the U.S. Fish and Wildlife Service that have not been previously addressed in the Environmental Assessment.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
400 RALPH PILL MARKETPLACE
22 BRIDGE STREET
CONCORD, NEW HAMPSHIRE 03301-4901

Colonel Thomas A. Rhen
Division Engineer
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254

MAY 1 1 1988

Dear Colonel Rhen:

A draft feasibility report and environmental assessment for the modification of the existing navigation project in Boston Harbor, Massachusetts was provided to us on February 26, 1988. We had been earlier advised that the draft would be available by early January 1988, with our comments due by mid-February. Mr. Ron Joseph had been assigned to this project but reaigned and his last day was the same day that we received the draft. His replacement will report in early June. We apologize for our delay.

Our principal issue is the continual disposal of dredged material at the Boston Foul Area, without full comparison of all disposal alternatives and consideration of cumulative impacts. The Fish and Wildlife Service has participated in the interagency coordination for several years studying disposal problems at the Foul Area. Therefore, we continue to remain concerned that polluted sediments will not be adequately contained within the Foul Area. There are indications that fine grained non-cohesive materials are being dispersed into the Massachusetts Bay environment.

Previous use of the Foul Area should not eliminate an explanation of all disposal alternatives in the environmental assessment (EA). The EA is deficient because it relies primarily on engineering cost and convenience. Deferring bioassay/bioaccumulation testing until the post authorization studies implies that the Foul Area is acceptable without reservation. We also question how a benefit/cost ratio can be developed for project authorization without full considerations of all cost and environmental constraints on spoil disposal.

The EA does not adequately address cumulative impacts to the Foul Area. The proposed improvements to Boston Harbor will require the disposal of about 2.3 million cubic yards of material presumably at the Foul Area. In addition, some of the 8 million cubic yards of dredged and excavated material for the Central Artery/Third Harbor Tunnel Project could also be considered for disposal there, as well as the many private maintenance dredging projects in the Boston Harbor/Mystic River/Chelsea River area.

Boston Harbor is among the most contaminated harbors in the United States, yet there is no containment facility for disposal of materials dredged from the harbor. Several researchers have reported fin rot and tumors in the harbor's

fish, while others have reported azoic conditions in sediments in certain reaches of the inner harbor. These toxic and carcinogenic sediments are widespread in the harbor. Disposal of these contaminated sediments in open ocean waters would clearly not comply with the Ocean Dumping Act's statement of congressional policy "...to prevent or strictly limit the dumping into ocean waters of any material which would adversely affect human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities." The adverse impacts that the Act seeks to prevent are presently occurring in the harbor because of the contaminants contained in sediments. Transporting of these of contaminants and related adverse impacts from the harbor to the open ocean will increase the area and resources affected. Containment in either upland or in shallow waters, such as accomplished by the Corps in the southern United States, will reduce the adverse effect cited above, and meet the intent of the Act.

The EA acknowledges that a containment facility for spoil disposal has been discussed by State and Federal agencies. However, the EA dismisses further discussion since no specific proposals for this alternative have been developed. We consider the current project as adequate reason for the Corps to develop sufficient cost and feasibility information on a spoil containment area for comparison with other alternatives.

It is not clear in the EA how the channel slopes will be created during the dredging. It appears that the material to be dredged will include sediments that have not been previously disturbed. We suspect that this sediment may contain a wide array of toxic contaminants. Deepening the channel to 40' in the inner harbor creates conditions favorable for anoxia (zero dissolved oxygen) due to salt and temperature stratification. Therefore, the existing uses by marine life could be precluded due to a lack of oxygen. These adverse impacts would need to be discussed.

We have also participated in the Interagency Committee for the Central Artery/Third Harbor Tunnel projects in conjunction with a supplemental EIS that is being prepared by the Federal Highway Administration (FHWA) to address certain issues. The disposal of approximately 8 million cubic yards of dredged and excavated material is a major issue in that study. Based on presentations at these Interagency Committee meetings, it appears that their supplemental draft EIS will be addressing issues similar in nature and scope. Also, there most likely will be waterfront development proposals to take advantage of the deeper channel. Therefore, the secondary development should be considered, much like the Federal Court ordered at the proposed Sears Island Marine Terminal. We recommended that the Corps defer further action until the supplemental EIS is completed. That study could then be referenced and this would allow full integration of all actions concerning disposal of polluted dredged sediments.

These comments are provided under authority of the Fish and Wildlife Coordination Act, National Environmental Policy Act, and related authorities, however, we feel that further coordination is desirable to address the spoil disposal issue and to develop a disposal strategy that satisfies the requirements of NEPA. In summary, we feel it is premature to submit this document to the Board of Engineers for Rivers and Harbors at this time.

Sincerely yours,

Gordon E. Beckett

Gordon E. Beckett
Supervisor
New England Area

APPENDIX VI

ENVIRONMENTAL ASSESSMENT

On 12 August 1988, the U.S. Fish and Wildlife Service provided an additional Coordination Act Report. (see page EA-VI-2).

Page 1, Paragraph 3: FWS suggests New England will undergo a long-term trend away from use of petroleum based fuels. The economic analysis of this project does not predict any changes and benefits are derived from efficiency improvements, therefore the project is needed and economically justified as stated in the main report.

Page 1, Paragraph 4: The channel dimensions, as proposed, represents the most economically justifiable, navigationally efficient and safe dimensions practical.

Page 2, Paragraph 1: The EA fully identifies the dissolved oxygen problem and documents the biological impacts. The discussion of water column tidal prism exchange clearly delineates NED's position the minor improvements to existing channels will not degrade or exacerbate water quality problems.

Page 2, Paragraph 2: As stated previously, the improvement dredging will increase transport efficiency. Therefore there should not be an increase in potential exotic organism introductions.

Page 3, Paragraph 1: Bioassay/bioaccumulation testing will be conducted to determine disposal suitability of dredged material. (see also page EA-IV-iii).

Page 3, Paragraph 2: The EA adequately reflects the project and its impacts and NED has addressed all FWS concerns. (see also page EA-IV-iii).

Page 3, Paragraph 3: The cumulative impact of dredging and filling of all of Boston Harbor is beyond the necessary scope of this document.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
400 RALPH PILL MARKETPLACE
22 BRIDGE STREET
CONCORD, NEW HAMPSHIRE 03301-4901

Colonel Thomas A. Rhen
Division Engineer
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254

AUG 12 1988

Dear Colonel Rhen:

This is our Fish and Wildlife Coordination Act Report on your feasibility study for navigation improvements to Boston Harbor, Boston, Massachusetts. It is submitted in accordance with the Fish and Wildlife Coordination Act, 16 U.S.C. 661 et seq. These comments supplement those provided to New England Division on August 20, 1987 and May 11, 1988.

We understand that consideration is currently being given to reducing the dimensions of some sections of the Reserved and Mystic River Channels as previously identified in your draft feasibility report dated February 1988. In addition, some consideration is being given to deleting the Chelsea River Channel from the project and adding the North Approach Channel in the vicinity of Finns Ledge back into the proposed plan.

During our review of the purpose and need for this project, which is based largely on the shipment of petroleum products, we realized that other energy projects in the New England states could have a significant bearing on the utilization of the Boston Harbor Navigation Project. During the fall of 1987, the Federal Energy Regulatory Commission (FERC) held an open season on applications for the so-called Northeast Pipeline Projects (Docket No. CP 87-451-000 et al). Several other natural gas facilities have previously been proposed in New England independent of the former. In addition, the energy mix for New England is being changed by the addition of biomass (wood, refuse, etc.), coal, and hydro projects including Hydro Quebec and energy conservation programs. Given this trend away from petroleum based fuels (fuel oil, residual oil, etc.) as the present and future scenario for the Boston area, it would seem reasonable that some sections of the project might not be needed and/or economically justified. We believe this issue needs to be carefully evaluated because public resources could be needlessly damaged if the project is authorized and constructed as proposed and then not fully utilized because these alternative energy sources have displaced significant amounts of petroleum. In effect, the environment in this region would endure a double impact scenario due to ineffective long-term planning by state and federal agencies.

Considerable variation exists with respect to channel dimensions in different portions of the Boston Harbor Project. For example, the width of the Chelsea River Channel, which is the longest channel segment being investigated, would vary from 225 to 300 feet wide, while the Mystic Channel would vary from 940 to 1060 feet in width and the Reserved Channel would be 400 feet in width. We

note that the width of the Reserved Channel was reduced from 430 to 400 feet because of foundation problems with adjacent structures. This fact plus the great variety of existing channel dimensions strongly suggests that considerable opportunity exists to minimize habitat alteration by reducing the width, length and to a lesser extent the depth of the proposed channels (assumes channel deepening to 38 or 40 feet as a given). We must assume that the 225-foot width of the Chelsea River Channel or something less is adequate for the types of ships that are projected to use the various Boston Harbor Channels; otherwise, it would not be used. Therefore, we believe the project should be reformulated using the minimum channel size necessary for ships to navigate these channels. We assume the Corps would investigate a variety of widths ranging from 96 to 225 feet, since these represent both existing and proposed conditions on the Chelsea River, to determine the minimum channel width for the Boston Harbor Project.

Several areas in Boston's Inner Harbor stratify during the summer with the bottom strata of water developing low levels of dissolved oxygen (D.O.) or in many cases zero D.O. These proposals to deepen and otherwise enlarge the Mystic, Chelsea and Reserved Channels have the potential to increase, spatially and temporally, the areas of Boston Harbor subject to low or zero D.O. We could find no data in the draft feasibility report that accurately depicts, both spatially and temporally, the existing stratification pattern for D.O., temperature and salinity isopleths, much less evaluate how the proposed project could exacerbate this already unacceptable water quality problem. Living resources are lost and/or excluded from these D.O. limited areas on an annual basis presently and we remain concerned that this project will make the problem worse, both temporally and spatially, despite the attempts being made to rectify other water quality problems in Boston Harbor. Because of these water quality related issues, we are concerned that the project may not comply with the antidegradation policy contained in Massachusetts (314 CMR 4.04) and Federal water quality standards regulations (40 CFR 131.12) because existing standards are not being met and this project could exacerbate some of these current problems to include the loss of some existing uses.

Recently, researchers in various locations have expressed concern about the potential for ocean vessels to introduce exotic organisms into various waters of the United States. This phenomenon generally occurs when vessels discharge bilge or ballast water taken up in a foreign country into harbors or channels in this country. While we can assume that this activity has been practiced in Boston Harbor for some time, we have virtually no information available that would assist us in determining how the proposed project would affect this practice. Therefore, we believe this issue needs to be explored and evaluated prior to the development of the final feasibility report.

The issues concerning dredge material testing and disposal site selection remain unresolved. These issues were discussed in our August 20, 1987 and May 11, 1988 letters. We continue to believe that dredge material testing is a prerequisite to disposal site selection. In the case at hand, two very different types of dredge material need to be tested separately and in all probability, disposed in different sites by different methods. These include the new deposition or maintenance type of dredge material which we believe is contaminated and highly toxic to sensitive species; and the parent or undisturbed native dredge material that we presently have no reason to suspect would be contaminated above natural background levels. In our opinion, it is premature to be requesting authorization of this project until the dredge material testing has been completed, thus providing the necessary information to conduct an appropriate study of alternative disposal methods and sites. We anticipate that a confined disposal site will be necessary to dispose the maintenance type material in an ecologically acceptable manner. The clean undisturbed parent material would probably be acceptable for ocean disposal at the Foul Area or perhaps for some beneficial use.

The environmental assessment (EA) included in the draft feasibility report does not adequately evaluate environmental effects or issues associated with the proposed project. The EA cannot do so because it is based on outdated and incomplete information. In fact, until the details of this project become known and articulated, we do not believe the Corps can determine if an EA is the proper NEPA document. Therefore, we must reserve final judgement on this issue until the complete Boston Harbor Project is defined, including development of the date and other information that we have requested in this and other recent correspondence.

The draft feasibility report contains a considerable amount of historical information concerning the development of Boston Harbor. However, no attempt has been made to quantify and evaluate the cumulative impacts of all dredging and filling activities in this harbor over this same time period. This information would be useful for determining the incremental impact associated with this project and for determining the project's overall environmental acceptability.

If you should have any questions concerning this or our previous reports, please contact me at 603-225-1411 or FTS 834-4411.

Sincerely yours,

Vern Lang
Acting Supervisor
New England Area

APPENDIX 3

ECONOMIC ASSESSMENT

FEASIBILITY STUDY
AND ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENTS

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Economics Appendix

Methodology

The economic justification of the proposed improvements was determined by comparing the average annual benefits accruing to the project over its economic lifespan to the equivalent average annual costs. In general, the benefits should equal to or exceed the costs for the Federal Government to participate in the project.

Benefits and costs are compared by putting them on an average annual basis using the interest and amortization rate of 8-5/8% currently applicable to Federal projects. The economic life of the project is considered to be 50 years.

For purposes of the study, Boston Harbor is divided into three areas: 1) Mystic River Channel, 2) Reserved Channel, and 3) Chelsea River Channel, Improvements in each of these areas must be justified separately.

Benefits

Benefits are defined as the reduction in the value of resources required to transport commodities. The proposed project would result in navigation benefits from projected savings in the cost of transporting primarily petroleum on the improved waterway. They would arise primarily through the use of larger vessels to obtain efficiencies of scale and reduced transportation costs. More efficient use of existing vessels would also occur due to reductions in tidal delays, lightering and lightloading.

Improved safety, though not directly quantifiable, would also be a benefit. The risk of collisions and/or groundings is partially dependent on the density of traffic. Deepening the channel would enable larger vessels to make fewer total trips, thus decreasing traffic and improving safety. The deepening would also allow vessels which currently must move within a few hours of high tide to use the waterway 24 hours a day, thereby permitting a vessel carrying LNG to exit at anytime.

The proposed deepening, by allowing for safer passage of ships and barges, would also result in a reduction in the risk of a major pollution incident occurring. By reducing traffic volume the proposed project would further minimize the potential for oil spills. The prevention of a pollution event involving oil or chemicals could mean saving extensive clean-up costs. (Although the use of larger vessels would reduce the expected frequency of an oil spill, the expected magnitude of the spill could increase.)

Economic Study Area and Transportation Network

Boston Harbor is one of the best natural harbors on the Eastern Seaboard as well as the location of the largest city and seaport in New England. Boston has an inner and outer harbor. The Inner Harbor, which lies north and west of a line drawn between Logan Airport and Castle Island, includes the mouths of the Charles, Mystic and Chelsea Rivers. The Outer Harbor is divided into the three bays of Dorchester, Quincy and Hingham which receive most of the tributary waters flowing into the harbor.

All modes of public, private, and commercial transportation generally used in the United States are available within the Boston Metropolitan area. The area is served by extensive highway and roadway systems including Interstates 90, 93 and 95, State Highways 3, 9, and 90. Daily passenger and freight rail service is provided to cities throughout the northeast by the Boston and Maine and Amtrak. Logan Airport provides facilities for both commercial and general aviation and is located only minutes from downtown Boston.

Other nearby transportation facilities include major ports and airports in Connecticut, Massachusetts, Rhode Island, and New Hampshire, a number of Interstate and State highways; and rail service connection to most of the northeastern United States and portions of Canada. These transportation facilities afford the region an extensive market for goods and services within a one to two-day delivery area.

Transportation within the metropolitan area is usually by private automobile, bus, train, or taxi. A small percentage of passenger transportation is provided by private aircraft, boats, or ferry. Freight is primarily carried by truck, freighter or barge. Rail transport also accounts for a notable volume of freight within the region.

Multiport Analysis

A multiport analysis is not conducted since there were no indications present in the course of discussions with terminal operators that commodity flows to competing port hinterlands would significantly shift if Boston were to be deepened on incremental five feet to a controlling depth of 40 feet. The ports of New Haven, with an intraregional petroleum products pipeline to mid-Massachusetts from Long Island Sound, and Fall River, with a pipeline to Boston and Springfield (Westover Air Force Base) from Mt. Hope Bay are both presently at 35 feet. Providence is already at 40 feet while Portsmouth and Portland are also at 35 feet.

It is important to note that the benefits accruing to the incremental deepening of Boston Harbor are derived almost entirely (95%) from the more efficient imporation of petroleum products. Lacking indigenous supplies, New England must obtian all the petroleum products it consumes from oil-producing regions of the United States and from abroad. The region has no refineries and almost all the product flows imported are refined such as

distillate, residual, diesel, gasoline, naptha, kerosene,etc. Ports of origin for most of this product are the New York/New Jersey area, the Gulf, Carribean and Venezuela. Nor does New England have petroleum products pipelines connecting it with the rest of the United States. It is therefore expected that tankers and barges will be used for the forseeable future to bring in these commodities. Nearly all this oil is brought into 17 major ports with each port serving its own market area with only slight overlaps. A fundamental criteria for conducting a multiport study is that there be overlapping hinterlands.

Structural modifications to Boston Harbor are not expected to alter its anticipated level of petroleum product or other bulk commodity receipts. Since the major competing ports with Boston are fairly equal as to depth, even with another five feet, other factors appear to have a greater influence on the amount of commodity flows into each port. It is believed that since petroelum shipments make up more than 65 percent of all the traffic passing through New England ports, changes in demand for petroleum products could significantly alter the total number of vessels using these ports. In addition, variatins in petroleum demand among the market areas of New England would more likely to result in changes in the destribution of product volume among the ports rather than an incremental deepening of one particular port. Such factors as energy conservation and manufacturing trends from heavy to light industries are extremely strong in New England. A prime example is Westbrook Paper Company's changing use of oil to wood chips for energy and the subsequent drastic reduction in residual fuel brought into Portland Harbor.

In theory, the most important factor in determining commodity flows through each port should be the total cost of transporting the commodity from its origin to its market area. However, it is felt that savings in deep draft transportation costs resulting from commodity shifts to Boston would not be significant enough to neutralize or overcome additional land-based transfer costs to new market areas. For example, in a study done for the New England Division in 1979, it was found that 15.8% of Massachusetts' consumption of distillate (home heating) oil was actually imported through the port of New Haven in 1977. This results from the use of the "Jet Lines Company" pipeline running from New Haven to Springfield, Massachusetts serving the mid-Massachusetts market area. Recent discussions with shipping interests at New Haven indicate that this method of serving the market aera is by far still the most economical means available. Any cost advantage resulting from serving this area through Boston with cheaper tanker per-ton costs would be overcome by high additional land based costs for either rail or truck transportation from Boston to Springfield. Only serious supply problems or logistical considerations would prohibit the use of the most economical transport route.

In summary, there would have to be highly significant cost savings to bring about a change in the way markets are currently served through a shift in commodity flows. Such cost savings cannot be forseen at this time.

TABLE 3-1

ESTIMATED PERCENTAGE OF STATES' CONSUMPTION OF PETROLEUM PRODUCTS SERVED BY EACH PORT IN 1977

	Residual	Distillate	Gasoline	Jet Fuel	Liquid Gas	Naptha
Maine						
Penobscot R.	22.3	25.0	25.0	50.0	-	-
Searsport	45.9	4.5	5.0	18.5	-	-
Portland	31.8	70.5	70.0	31.5	-	-
Portsmouth	-	-	-	-	100.0	-
Boston	-	-	-	-	-	100.0
New Hampshire						
Portland	61.4	3.0	39.0	-	-	-
Portsmouth	38.6	64.0	11.0	100.0	26.0	-
Boston	-	33.0	50.0	-	74.0	100.0
Massachusetts						
Portsmouth	5.6	-	-	-	-	-
Salem	10.6	5.0	-	-	-	-
Boston	52.3	56.0	66.0	93.0	92.0	3.5
New Bedford-Fairhaven	2.6	0.2	-	-	-	-
Fall River	16.8	11.0	11.5	7.0	0	90.0
Providence	3.1	9.0	13.4	-	8.0	2.0
New Haven	9.0	15.8	8.7	-	-	3.5
Other	-	3.0	0.5	-	-	-
Rhode Island						
Providence	100.0	100.0	99.9	100.0	100.0	100.0
Other	-	-	0.1	-	-	-
Connecticut						
Boston	-	-	-	-	50.0	0
Providence	-	2.0	9.2	-	50.0	10.0
New London	19.2	5.6	0.2	-	-	-
Thames R	0.9	4.5	2.1	-	-	-
Connecticut R.	18.0	9.9	13.1	25.5	-	-
New Haven	18.9	43.0	52.8	73.3	-	90.0
Housatonic R.	8.8	-	2.0	-	-	-
Bridgeport	22.4	17.0	20.0	1.2	-	-
Norwalk	10.3	5.6	0.2	-	-	-
Stamford	1.5	12.4	0.4	-	-	-

Types and Volumes of Commodity Flows

Boston is the largest commercial port in New England, shipping and receiving approximately 21 million tons of waterborne commerce in 1986. A comparative statement of commerce for the twenty-year period 1967-1986 appears in Table 2. The declines in tonnage over this period are due primarily to the drop in imports of distillate and residual fuel oil. Historical summaries of commerce for the period 1972-1986 are presented in Tables 3 and 5.

The primary commodity group of petroleum products, over the last 18 years, averaged 89% of total waterborne commerce. Other major commodities are iron and steel scrap, building cement, and sugar. Table 4 compares petroleum commerce to total commerce for major New England ports.

TABLE 3-2
Comparative Statement of Commerce
Boston Harbor, Massachusetts

Year	Short Tons	Percent Increase (Decrease
1986	21,035,972	21.8
1985	17,268,816	(13.2)
1984	19,888,675	16.7
1983	12,036,478	(3.2)
1982	17,593,627	(13.4)
1981	20,306,450	(7.8)
1980	22,033,922	(16.4)
1979	26,342,672	1.0
1978	26,073,590	0.4
1977	25,975,275	(0.8)
1976	25,172,442	5.9
1975	24,719,452	(3.9)
1974	25,728,945	(4.9)
1973	27,056,868	2.2
1972	26,483,438	1.3
1971	26,156,517	(2.7)
1970	26,867,918	8.3
1969	24,610,760	9.8
1968	22,610,760	4.9
1967	21,549,086	

Source: Waterborne Commerce of the United States

Table 3-3
HISTORICAL COMMODITY TRENDING OF DEEP DRAFT COMMERCE

COMMODITY	1981	1980	1979	1978	1977	1976	1975	1974	1973	1972
Total Tonnage	- 20,306,450	22,033,922	26,342,672	26,073,590	25,995,275	26,172,442	24,719,452	25,728,945	27,056,868	26,643,438
Gasoline	6,071,168	6,265,165	7,022,531	7,054,329	6,676,934	6,196,597	6,394,833	5,586,531	6,033,658	5,478,438
Jet Fuel	795,344	849,495	1,157,917	989,537	1,057,029	666,697	766,702	685,863	676,509	712,154
Kerosene	167,951	269,181	383,429	403,179	530,101	697,755	579,976	875,366	687,931	659,472
Distillate	4,766,507	5,919,151	7,235,970	7,426,687	6,840,161	7,599,439	8,145,149	8,038,040	7,135,933	8,669,164
Residual	4,925,010	5,467,420	6,975,794	6,758,940	7,364,469	7,750,260	5,952,354	7,035,125	8,292,152	7,791,151
Liquified Gases	1,021,089	614,191	818,827	377,526	538,739	459,529	338,667	164,513	378,956	90,005
Asphalt, Tar & Pitches	278,550	271,206	343,537	461,190	427,208	437,064	359,255	377,131	442,043	205,736
Iron & Steel Scrap	380,749	576,963	620,379	605,530	332,876	349,985	421,300	666,213	613,128	603,397
Building Cement	219,250	248,349	240,791	314,941	288,324	276,905	321,068	475,630	475,485	331,495
Limestone	155,896	159,615	176,687	154,347	164,068	130,490	117,854	178,527	192,227	152,616
Salt	28,154	33,073	3,811	109,429	361,016	236,352	203,882	47,745	88,493	212,963
Sugar	444,272	439,967	389,128	434,767	533,105	430,466	303,833	403,610	460,378	496,496

COMMODITY	1982	1983	1984	1985	1986
Total Tonnage	17,593,627	17,036,478	19,888,675	17,268,816	21,035,972
Gasoline	5,638,181	5,454,296	5,933,955	5,871,973	6,047,852
Jet Fuel	951,374	1,003,180	1,026,432	887,178	856,794
Kerosene	107,369	125,385	135,382	167,642	147,145
Distillate	4,322,521	3,792,800	5,890,854	5,296,143	6,369,395
Residual	3,450,727	3,183,506	3,277,947	1,802,692	4,855,950
Liquified Gases	771,794	856,316	872,301	555,481	732
Asphalt, Tar & Pitches	263,268	235,195	249,889	190,857	218,778
Iron & Steel Scrap	309,393	514,949	782,876	676,663	426,067
Building Cement	288,993	292,244	325,447	488,069	687,739
Limestone	142,308	0	0	0	0
Salt	283	133,514	174,057	49,453	42,170
Sugar	414,442	315,647	232,251	184,908	166,470

TABLE 3-4
Total Waterborne Commerce and Petroleum Commerce
in the
Ten Largest New England Ports
(Short tons)
1981

Port	Tonnage	Petroleum Tonnage	Percent Petroleum
Boston, MA	20,306,450	18,315,575	90.2
Portland, ME	14,752,985	13,910,759	94.3
New Haven, CT	9,085,423	8,265,566	91.0
Providence, RI	7,043,882	6, 251,613	88.8
Chelsea River, MA (Incl. in Boston)	7,513,060	7,055,630	94.0
Mystic River, MA	6,325,473	5,683,820	89.9
Fall River, MA	3,635,123	3,581,486	98.5
Portsmouth, NH	3,072,214	2,501,139	81.4
Bridgeport, CT	3,072,214	2,501,139	81.4
New London, CT	1,782,208	1,558,845	87.5

Source: Waterborne Commerce

TABLE 3-5

HISTORICAL SUMMARY OF COMMERCE
AT BOSTON HARBOR
(SHORT TONS)

Year	Total	Foreign		Domestic			
		Imports	Exports	Coastwise Receipts	Coastwise Shipments	Internal Receipts	Local
1986	21,035,972	10,585,681	503,141	8,119,851	1,092,045	35,740	699,314
1985	17,268,816	6,851,540	757,165	8,165,194	1,047,033	8,391	439,493
1984	19,888,675	7,655,355	876,859	9,677,014	1,109,709	-	569,938
1983	17,036,478	5,397,293	623,046	9,724,762	921,883	12,562	356,932
1982	17,593,827	4,740,215	497,916	11,124,362	802,580	7,737	410,817
1981	20,306,450	6,778,480	578,641	10,788,584	1,331,530	13,360	815,875
1980	22,033,922	5,192,062	835,615	12,987,087	1,831,352	15,405	1,172,401
1979	26,342,672	7,302,197	852,353	14,170,126	2,795,511	13,584	1,208,899
1978	26,073,590	6,712,290	794,267	14,670,331	2,646,701	11,978	1,238,023
1977	25,975,275	7,547,246	501,847	14,443,836	2,457,207	9	1,025,130
1976	26,172,442	7,133,685	534,599	14,294,815	2,971,199	740	1,237,404
1975	24,719,452	6,987,864	546,592	14,148,029	2,665,813	11,158	1,360,196
1974	25,728,945	8,397,307	881,399	12,215,982	3,059,092	362	1,174,803
1973	27,056,868	10,189,201	816,240	13,149,652	1,935,208	12,392	954,175
1972	26,483,638	7,872,977	757,707	14,597,257	1,755,863	10,749	1,468,885

Source: Waterborne Commerce

Projections of Petroleum Product Shipments

Mr. Robert McIntyre, an economist for the Board of Engineers for Rivers and Harbors (BERH), at the request of the New England Division, developed a set of projections for the shipment of oil products through 19 New England ports. Projections were based on forecasted consumption of oil products made by the U.S. Department of Energy for New England. Individual port projections were based on each ports past share of total New England shipments. Forecasts assume price stability, moderate economic growth and consumption patterns in New England that are similar to the rest of the nation. The base year is 1985 and forecasts were made for the years 1990, 1995 and 2000. Forecasts for Boston are shown in Table 6.

TABLE 3-6
PROJECTED PETROLEUM COMMERCE FOR DEEP-DRAFT TRAFFIC IN BOSTON

(THOUSANDS OF SHORT TONS)

	Actual				Projected		
Commodity Petroleum Products	1980	1983	Base Year 1985	1990	Year 1 1995	Year 5 2000	Year 50 2045
Residual	5467	3184	1803	1579	2823	4530	4530
Distillate	5919	3793	5296	5900	5798	5484	5484
Gasoline	6265	5545	5872	5771	5378	5309	5309
Jet Fuel	849	1003	887	1040	1047	1111	1111
Liquid Gas	614	856	555	583	583	583	583
Naptha	26	10	3	3	3	3	3
Kerosene	269	125	167	155	155	143	143
Asphalt	271	235	191	191	184	177	177

Source: Robert McIntyre, BERH, 1987

World Fleet

Tables 7 and 8 show the number, age, size, and draft ditribution of the foreign and US tanker fleets as of January 1, 1985. With the Chelsea, Mystic, and Reserve Channels at 35 feet, and assuming three feet of underkeel clearnace, Table 7 indicates that practiclly all foreign flag vessels under 20,000 DWT can enter Boston Harbor fully loaded without tidal assistance. Of the foreign flag vessels between 20,000 and 40,000 DWT, 342, or approximately 35 percent, can enter without restrictions. Very few foreign flag tankers greater than 40,000 DWT can enter the project area channels fully loaded without tidal assistance.

An analysis of data in Table 8 indicates a similar situation with the US fleet. All ships under 20,000 DWT can enter without delay while only 17 (17 percent) vessels between 20,000 and 40,000 DWT can enter the project channels at low tide fully loaded.

The US tanker fleet in 1985 numbering 247 comprised approximately five percent of the world fleet of 5,483. Almost half the foreign fleet is under 20,000 DWT whereas the largest number of US tankers by size is between 20,000 and 40,000 DWT (approximately 40 percent).

Improvement dredging in the project area channels would increase the number of foreign flag tankers in the 20,000 to 40,000 size class that could use the harbor unrestricted to 935 or 96 percent of the vessels in this size class. Additionally, the number of vessels that could use the harbor fully loaded with tidal assistance would increase to 81 in the 40,000 to 60,000 DWT class (approximately 24 percent of vessels in this size class) and 27 in the 60,000 to 80,000 DWT class (approximately 10 percent of vessels in this size class).

As for the US flag tanker fleet an increase in channel depth to 40 feet would increase to 98 from 17 (approximately 96 percent of vessels in this size class) the number of ships in the 20,000 to 40,000 DWT class that could enter the project channels unrestricted by tide. Eighteen of the ships in the 40,000 to 60,000 DWT class (approximately 41 percent) would be able to navigate the harbor free of depth restrictions as well as 14 vessels in the 60,000 to 80,000 DWT class (approximately 50 percent).

As for future trends in the composition of the world tanker fleet, Table 9 indicates that in comparing the world tanker fleet between 1975 and 1985 the number of ships between 20,000 and 80,000 DWT has declined while the smallest ships, under 20,000 DWT and the largest ships over 80,000 DWT, have increased. Future buildings plans as of January 1, 1986 are summarized below:

Table 3-7

FOREIGN FLAG
MERCHANT TYPE TANKERS
SHOWING NUMBER, YEAR BUILT, SPEED, DRAFT & DEADWEIGHT TONNAGE
OCEAN GOING SHIPS OF 1,000 GROSS TONS & OVER
AS OF JANUARY 1, 1985

YEAR BUILT	TOTAL	NUMBER 20,000	DEADWEIGHT TONS 20,000 39,999	40,000 59,999	60,000 79,999	80,000 99,999	100,000 124,999	125,000 149,999	150,000 199,999	200,000 249,999	250,000 299,999	300,000 349,999	350,000 AND OVER
PRIOR TO 1941	27	27	-	-	-	-	-	-	-	-	-	-	-
41	2	2	-	-	-	-	-	-	-	-	-	-	-
42	2	2	-	-	-	-	-	-	-	-	-	-	-
43	10	7	3	-	-	-	-	-	-	-	-	-	-
44	11	11	-	-	-	-	-	-	-	-	-	-	-
45	22	10	6	-	-	-	-	-	-	-	-	-	-
46	1	1	-	-	-	-	-	-	-	-	-	-	-
47	3	3	-	-	-	-	-	-	-	-	-	-	-
48	7	7	-	-	-	-	-	-	-	-	-	-	-
49	11	6	5	-	-	-	-	-	-	-	-	-	-
50	10	9	-	1	-	-	-	-	-	-	-	-	-
51	29	20	-	-	-	-	-	-	-	-	-	-	-
52	16	14	-	2	-	-	-	-	-	-	-	-	-
53	18	15	1	2	-	-	-	-	-	-	-	-	-
54	31	27	3	1	-	-	-	-	-	-	-	-	-
55	29	22	7	-	-	-	-	-	-	-	-	-	-
56	39	21	16	1	-	1	-	-	-	-	-	-	-
57	46	26	14	6	-	2	-	-	-	-	-	-	-
58	80	40	29	10	-	1	-	-	-	-	-	-	-
59	80	37	24	15	2	-	2	-	-	-	-	-	-
60	74	35	27	13	2	-	1	-	-	-	-	-	-
61	85	45	21	11	2	1	-	-	-	-	-	-	-
62	98	50	27	14	-	2	-	1	-	-	-	-	-
63	79	45	9	24	6	1	-	-	-	-	-	-	-
64	112	44	20	26	17	5	-	-	-	-	-	-	-
65	147	71	18	18	31	7	4	-	-	-	-	-	-
66	132	55	16	16	27	16	1	2	-	1	-	-	-
67	142	80	10	2	12	22	13	1	2	-	-	-	-
68	175	112	21	2	7	15	11	1	2	6	-	-	-
69	187	126	25	2	5	11	9	1	6	2	1	1	-
70	176	109	26	1	2	6	9	4	4	16	3	-	-
71	216	133	35	4	1	3	-	9	2	26	7	-	1
72	190	98	38	1	-	4	5	5	1	17	21	-	-
73	275	110	65	8	5	4	7	10	1	27	40	-	2
74	337	102	59	6	11	23	10	17	2	29	40	5	2
75	389	84	84	9	5	43	14	16	5	27	12	13	12
76	343	97	76	11	5	30	8	22	13	20	31	11	10
77	219	83	44	15	10	8	9	12	13	1	11	5	13
78	148	62	35	14	9	6	9	1	5	1	5	2	1
79	161	107	22	20	11	11	6	2	2	-	3	1	2
80	223	124	25	22	15	27	7	1	1	-	1	1	-
81	276	148	45	21	33	21	2	-	1	1	3	-	1
82	237	114	65	31	16	8	-	1	1	-	1	-	-
83	177	93	42	15	12	8	-	4	-	-	1	2	-
84	126	79	17	8	17	2	1	1	7	1	-	-	-
TOTALS	5,217	2,527	971	363	261	394	104	144	63	181	269	61	57
AVERAGE AGE	12	13	12	13	10	10	12	9	9	11	10	8	9
SPEED KNOTS													
06	1	1	-	-	-	-	-	-	-	-	-	-	-
07	1	1	-	-	-	-	-	-	-	-	-	-	-
08	11	11	-	-	-	-	-	-	-	-	-	-	-
09	24	24	-	-	-	-	-	-	-	-	-	-	-
10	82	82	-	-	-	-	-	-	-	-	-	-	-
11	256	256	-	-	-	-	-	-	-	-	-	-	-
12	477	474	2	-	-	1	-	-	-	-	-	-	-
13	877	854	9	2	7	1	-	1	-	-	2	-	-
14	890	571	67	16	12	4	1	1	7	6	1	1	2
15	1,044	254	371	75	71	94	35	40	11	20	58	18	9
16	1,393	139	342	122	104	149	57	77	42	171	175	29	43
17	444	30	146	109	34	31	11	8	7	76	11	-	1
18	51	8	24	16	-	-	-	3	-	-	-	-	-
19	22	2	7	1	11	1	-	-	-	-	-	-	-
20	23	-	5	1	17	2	-	-	-	-	-	-	-
21	2	-	-	1	1	-	-	-	-	-	-	-	-
TOTALS	5,217	2,527	971	363	261	394	104	144	63	181	269	61	57
AVERAGE SPEED	13	13	13	13	13	13	13	14	14	13	13	14	14

Table 3-7 (continued)

FOREIGN FLAG
MERCHANT TYPE TANKERS (CONTINUED)
INCLUDES OWNERS, YEAR BUILT, SPEED, DRAFT & DISPLACEMENT TONNAGE
OCEAN GOING SHIPS OF 1,000 GROSS TONS & OVER
AS OF JANUARY 1, 1985

DRAFT FEET	TOTAL	DISPLACEMENT TONS												
		UNDER 20,000	20,000 - 39,999	40,000 - 59,999	60,000 - 79,999	80,000 - 99,999	100,000 - 124,999	125,000 - 149,999	150,000 - 199,999	200,000 - 249,999	250,000 - 299,999	300,000 - 349,999	350,000 AND OVER
08	1	1	-	-	-	-	-	-	-	-	-	-	-
10	3	3	-	-	-	-	-	-	-	-	-	-	-
11	44	44	-	-	-	-	-	-	-	-	-	-	-
12	43	43	-	-	-	-	-	-	-	-	-	-	-
13	91	91	-	-	-	-	-	-	-	-	-	-	-
14	92	92	-	-	-	-	-	-	-	-	-	-	-
15	135	135	-	-	-	-	-	-	-	-	-	-	-
16	161	161	-	-	-	-	-	-	-	-	-	-	-
17	170	170	-	-	-	-	-	-	-	-	-	-	-
18	214	214	-	-	-	-	-	-	-	-	-	-	-
19	212	212	-	-	-	-	-	-	-	-	-	-	-
20	188	188	-	-	-	-	-	-	-	-	-	-	-
21	136	136	-	-	-	-	-	-	-	-	-	-	-
22	211	211	-	-	-	-	-	-	-	-	-	-	-
23	187	187	-	-	-	-	-	-	-	-	-	-	-
24	99	99	-	-	-	-	-	-	-	-	-	-	-
25	56	56	-	-	-	-	-	-	-	-	-	-	-
26	73	73	-	-	-	-	-	-	-	-	-	-	-
27	69	62	3	-	-	-	-	-	-	-	-	-	-
28	65	63	-	-	-	-	-	-	-	-	-	-	-
29	81	78	3	-	-	-	-	-	-	-	-	-	-
30	121	106	15	-	-	-	-	-	-	-	-	-	-
31	224	98	123	3	-	-	-	-	-	-	-	-	-
32	134	24	110	-	-	-	-	-	-	-	-	-	-
33	98	10	84	-	-	-	-	-	-	-	-	-	-
34	84	4	80	3	1	-	-	-	-	-	-	-	-
35	109	2	102	4	1	-	-	-	-	-	-	-	-
36	226	-	210	12	4	-	-	-	-	-	-	-	-
37	171	-	149	21	1	-	-	-	-	-	-	-	-
38	107	-	52	34	16	-	-	-	-	-	-	-	-
39	126	2	10	90	9	6	-	-	-	-	-	-	-
40	134	-	12	64	35	23	-	-	-	-	-	-	-
41	91	-	-	36	29	8	-	-	-	-	-	-	-
42	120	-	1	28	71	20	-	-	-	-	-	-	-
43	66	-	1	17	31	17	-	-	-	-	-	-	-
44	71	-	-	3	30	42	-	-	-	-	-	-	-
45	40	-	1	4	10	33	1	-	-	-	-	-	-
46	54	-	-	-	7	44	3	-	-	-	-	-	-
47	40	-	1	1	2	32	4	-	-	-	-	-	-
48	27	-	1	-	-	16	8	1	-	-	-	-	-
49	41	-	-	-	-	22	10	1	-	-	-	-	-
50	35	-	-	-	1	8	14	1	7	-	-	-	-
51	25	-	-	-	-	10	11	-	4	-	-	-	-
52	9	-	-	1	-	-	6	1	1	-	-	-	-
53	14	-	-	-	-	1	6	1	6	-	-	-	-
54	16	-	-	-	-	1	4	4	7	-	-	-	-
55	77	-	-	-	-	1	71	4	1	-	-	-	-
56	89	-	-	-	-	1	2	44	19	-	-	-	-
57	29	-	-	-	-	-	4	12	3	-	-	-	-
58	2	-	-	-	-	-	-	-	1	1	-	-	-
59	4	-	-	-	-	-	-	-	3	1	-	-	-
60	4	-	-	-	-	-	-	2	0	2	-	-	-
61	8	-	-	-	-	-	-	-	7	1	-	-	-
62	23	-	-	-	-	-	-	-	6	11	-	-	-
63	14	-	-	-	-	1	-	-	-	13	-	-	-
64	65	-	-	-	-	-	-	-	-	65	-	-	-
65	47	-	-	-	-	-	-	-	1	34	10	-	-
66	57	-	-	-	-	-	-	-	-	11	36	-	10
67	32	-	-	-	-	-	-	-	-	10	18	-	4
68	73	-	-	-	-	-	-	-	-	24	44	-	1
69	47	-	-	-	-	-	-	-	-	1	44	-	-
70	16	-	-	-	-	-	-	-	-	-	16	-	-
71	21	-	-	-	-	-	-	-	-	-	16	1	4
72	21	-	-	-	-	-	-	-	-	-	19	-	2
73	66	-	-	-	-	-	-	-	-	-	32	20	14
74	19	-	-	-	-	-	-	-	-	-	2	6	9
75	19	-	-	-	-	-	-	-	-	-	-	1	12
76	2	-	-	-	-	-	-	-	-	-	-	1	1
77	2	-	-	-	-	-	-	-	-	-	-	-	2
78	1	-	-	-	-	-	-	-	-	-	-	-	1
81	2	-	-	-	-	-	-	-	-	-	-	1	1
82	2	-	-	-	-	-	-	-	-	-	-	-	2
83	1	-	-	-	-	-	-	-	-	-	-	-	1
86	2	-	-	-	-	-	-	-	-	-	-	-	2
89	1	-	-	-	-	-	-	-	-	-	-	-	1
91	1	-	-	-	-	-	-	-	-	-	-	-	1
96	1	-	-	-	-	-	-	-	-	-	-	-	1
TOTALS	5,219	2,527	971	565	761	784	195	136	69	101	249	61	47
AVERAGE DRAFT	34	21	35	40	49	49	51	55	57	49	60	75	99

TABLE D-6

UNITED STATES, 1980
PERSONS UNDER

PERSONS BY FAMILY TYPE AND INCOME
INCLUDES NUMBER, YEAR BUILT, TENURE, AGENCY & DEVELOPMENT TYPE
BRIDGE BOSTON SHIFT OF 1,170 UNITS FROM 1 MORE
AS OF JANUARY 1, 1981

1980 FAMILY TYPE	TOTAL	UNDER 20,000	20,000 TO 29,999	30,000 TO 39,999	40,000 TO 49,999	50,000 TO 74,999	75,000 TO 99,999	100,000 TO 124,999	125,000 TO 149,999	150,000 TO 199,999	200,000 TO 249,999	250,000 TO 299,999	300,000 TO 349,999	350,000 TO 399,999	400,000 TO 449,999	450,000 OR MORE
FAMILY TO																
1941	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
42	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
43	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
44	0	1	0	-	-	-	-	-	-	-	-	-	-	-	-	-
45	4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
46	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
47	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
48	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
51	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
53	3	2	1	-	2	-	-	-	-	-	-	-	-	-	-	-
54	5	1	3	1	1	-	-	-	-	-	-	-	-	-	-	-
55	1	1	0	1	1	-	-	-	-	-	-	-	-	-	-	-
56	4	1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
57	1	1	0	1	-	-	-	-	-	-	-	-	-	-	-	-
58	0	1	0	-	-	-	-	-	-	-	-	-	-	-	-	-
59	12	1	2	2	1	-	-	-	-	-	-	-	-	-	-	-
60	3	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-
61	3	1	1	2	1	-	-	-	-	-	-	-	-	-	-	-
62	3	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-
63	3	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-
64	1	-	1	0	1	-	-	-	-	-	-	-	-	-	-	-
65	2	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-
66	1	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-
68	4	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-
69	1	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-
70	1	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-
71	6	-	3	-	3	2	-	-	-	-	-	-	-	-	-	-
72	5	-	3	-	1	1	-	-	-	-	-	-	-	-	-	-
73	4	-	1	-	-	3	2	-	-	-	-	-	-	-	-	-
74	10	-	4	-	-	5	1	1	-	-	-	-	-	-	-	-
75	14	1	6	2	-	3	1	-	-	-	-	1	-	-	-	-
76	11	1	3	-	-	3	-	-	-	-	-	2	-	-	-	1
77	16	-	3	1	2	6	-	-	-	-	1	2	-	-	-	1
78	12	-	-	-	3	4	1	-	-	-	3	-	-	-	-	1
79	11	-	1	-	0	3	1	-	-	-	3	-	-	-	-	2
80	4	-	1	-	2	-	-	-	-	-	1	-	-	-	-	-
81	10	-	1	0	-	-	-	-	-	-	3	-	-	-	-	-
82	6	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
83	3	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
84	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
TOTALS	247	20	102	66	29	30	9	2	10	6	1	-	-	-	-	2
ATTACHED																
DET	16	27	21	12	12	10	14	11	6	8	0	-	1			
DWELL																
UNITS																
10	0	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-
11	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	0	1	0	-	-	-	-	-	-	-	-	-	-	-	-	-
13	3	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
14	26	3	13	1	-	-	-	-	-	-	-	-	3	-	-	-
15	64	3	12	16	4	1	-	-	-	-	-	-	2	-	-	-
16	92	1	33	10	11	12	9	2	1	-	-	-	-	-	-	1
17	41	1	22	2	1	4	6	-	-	-	-	-	-	-	-	1
18	8	-	4	2	1	0	-	-	-	-	-	-	-	-	-	-
19	3	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-
20	11	-	1	1	10	-	-	-	-	-	-	-	-	-	-	-
TOTALS	247	20	102	66	29	30	9	2	10	6	1	-	-	-	-	2
ATTACHED																
SPACE	16	13	14	18	16	16	16	16	18	17	14	-	16			
BASEMENT																
PART																
13	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	0	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31	1	0	1	-	-	-	-	-	-	-	-	-	-	-	-	-
32	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
33	11	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-
34	13	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-
35	29	-	29	-	-	-	-	-	-	-	-	-	-	-	-	-
36	21	-	17	1	1	-	-	-	-	-	-	-	-	-	-	-
37	22	-	19	3	-	-	-	-	-	-	-	-	-	-	-	-
38	21	-	1	9	11	-	-	-	-	-	-	-	-	-	-	-
39	17	-	6	7	-	-	-	-	-	-	-	-	-	-	-	-
40	16	-	-	16	-	-	-	-	-	-	-	-	-	-	-	-
41	9	-	-	3	5	1	-	-	-	-	-	-	-	-	-	-
42	6	-	-	1	1	3	1	-	-	-	-	-	-	-	-	-
43	5	-	-	-	4	1	-	-	-	-	-	-	-	-	-	-
44	6	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-
47	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
48	2	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
49	12	-	-	-	-	12	-	-	-	-	-	-	-	-	-	-
52	6	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-
53	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
54	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
55	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
57	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
59	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
67	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
70	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
76	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
TOTALS	247	20	102	66	29	30	9	2	10	6	1	-	-	-	-	2
ATTACHED																
BASEMENT	46	23	33	39	48	47	33	46	37	39	67	-	76			

	Number	Total Deadweight Tons
1. Tankers delivered from construction		
U.S.	4	71,700
F.F.	147	4,607,200
2. Tankers under construction and/or an order		
U.S.	4	478,400
F.F.	260	10,019,700

On average, additions to the US fleet since 1985 appear to be in the 20,000 and 100,000 DWT size classes. Additions to the foreign fleet, on average, appear to be in the 20,000 to 40,000 DWT size class.

TABLE 3-9
WORLD TANK SHIP FLEET
UNDER 100,000 DWT

Deadweight Tonnage (thousands)	December 31, 1975 Number	December 31, 1975 Average Age (years)	January 1, 1985 Number	January 1, 1985 Average Age
Under 20	1547	14	2558	13
20 to 40	1291	14	1080	13
40 to 60	525	14	387	13
60 to 80	358	10	290	10
80 to 100	290	7	304	10
Total	4011	13	4619	13

World Fleet at Boston

The composition of the fleet currently serving terminals in the project area is shown in Tables 3-14 through 3-19 under the 35 foot channel depth. The data in each channel is obtained by aggregating terminal data. There are four terminals in the Mystic River, three in the Reserved Channel and six in the Chelsea River. Based on vessel movement data and vessel characteristics data provided by the Waterborne Commerce Statistical Center (WCSC) for domestic movements and information provided by WCSC, the Massachusetts Port Authority (MASSPORT) and terminals for foreign movements, tonnages by channel and fleet are shown below for 1983:

Channel	Tonnage US	Tonnage FF
Reserved	1,032,306	1,108,369
Mystic	1,405,226	2,080,536
Chelsea	5,009,309	1,243,082
TOTAL	7,446,841	4,431,987

As can be seen above, although the US fleet comprises only five percent of the world fleet, it accounted for approximately 60 percent of the tonnage carried to project beneficiaries in 1983.

The operating drafts of vessels visiting Boston Harbor from 1972 to 1985 are shown in Table 10. Beginning in 1979 there is a sharp decline in the number of vessels calling on Boston. Also the number of vessels drawing in excess of 35 feet declined from 202 in 1979 to 99 in 1985, a drop of approximately 51 percent. Part of tis decline is due to the general reduction in the number of vessels visiting Boston (a decline of 16 percent between 1979 and 1985). The remainder of the decline may be due to a desire by oil companies to keep inventories low in the face of a high real price for their product and a subsequent decline in the quantity demanded. In 1983, 69 vessels operating drafts exceeded the channel depth of 35 feet out of 970 trips by vessels with drafts in excess of 18 feet (approximately seven percent).

Terminals

The Mystic River project beneficiaries are:

Distrigas
Exxon
Boston Edison
Prolerized

All the above terminals are located on the north side of the Mystic River. Distrigas imports liquified natural gas. Exxon brings in a variety of refined oil products. Boston Edison imports residual oil for use in their Everett power plant. Boston Edison has an arrangement with Exxon to use its facility rather than their own. Boston Edison also rents 650,000 barrels of storage capacity from Exxon. Prolerized exports scrap metal to all parts of the world, but primarily to the Mediterranean and the Orient.

There are three terminals on the south side of the channel whose vessels do not experience any problems entering or exiting the channel at mean low water. These terminals are:

US Gypsum
Blue Circle Atlantic
Moran Container Facility (MASSPORT)

US Gypsum imports gypsum and Blue Circle Atlantic receives cement products. Container ships using the Moran facilities currently do not experience difficulties using the channel at mean low water. However, information provided by Massport indicates that Maersk Lines plan to use the Moran terminal to bring in vessels of the Marchan Maersk Class. This vessel fully loaded would contain 3,500 containers and draw 41 feet.

Massport estimates that the vessel would off-load about 300 containers in Boston. Shipments would originate in Copenhagen with Halifax, U.S. as the first port of call. Boston would be the second port of call with the vessel continuing to New York and Norfolk before returning to Copenhagen. Benefits are not taken on this traffic as Massport does not currently have information on the operational draft of these vessels.

Although Blue Circle Atlantic currently does not employ vessels drawing in excess of the channel depth they have indicated desire to use larger vessels if greater depth were provided in the Mystic River. However, correspondence from them indicates potential problems with deepening their berth below 35 feet. Thus benefits are not taken on this terminal.

Project beneficiaries in the Reserved Channel are Belcher, Boston Edison and Seaboard shipping lines. Belcher receives primarily home heating oil and residual oil used by heavy industrial plants. Boston Edison uses Belchers berth for the offloading of residual oil rather than its own facility. Boston Edison currently has a contract with Belcher to bring in residual oil, but the power company also schedules its own shipments under a separate agreement for the use of Belcher's facility. Boston Edison compares the contract price with the spot price in determining the source of its oil deliveries. Boston Edison rents 550,000 barrels of storage capacity from Belcher. Belcher's terminal is located on the south side of the channel.

Another beneficiary in the Reserved Channel is the Conley Terminal. Conley terminal is a containership facility owned by Massport. Three shipping lines, Sealand Services, Inc, Nedloyd and Trans Freight Lines (TFL) currently provide containership service under a vessel sharing agreement. The vessel is referred to as the "Atlantic Class Service". From information obtained from the United States Coast Guard (U.S.C.G.) this vessel has the following specifications:

Length 939 feet
Beam 105 feet
Draft 51.9 feet (fully loaded)
DWT 42,719

Fully loaded this vessel could hold 4,200 containers. It currently arrives in Boston lightloaded carrying 3,400 containers and drawing 32 feet. However, officials of Sealand and TFL indicate that the load line is determined by market conditions not channel depth. Shipments originate in Northern Europe at Felixstowe, U.K., Rotterdam or Bremerhaven with weekly calls at Boston, Port Elizabeth, N.J. and Norfolk, VA in that order before returning to Europe. Benefits are taken on expected increased loadings due to U.S. east coast growth in containership traffic.

Other potential beneficiaries are Coastal Cement and the Black Falcon Cruise Terminal owned by Massport. Coastal Cement is currently switching their operations to berths five and six on the north side of the Reserved

Channel. These berths were formerly part of the Boston Army base and are now owned by Massport. Massport is reluctant to deepen these berths beyond 35 feet as this might expose the apron of the seawall. Thus, Coastal Cement is not a beneficiary of channel deepening.

The Black Falcon Cruise Terminal is also located on the north side of the channel at former Boston Army Buse berths. However, the cruise ships using this facility do not need additional depth.

There are five oil terminals located upstream of the Chelsea St. Bridge. These terminals are:

Belcher
Gibbs
Global
Northeast
Gulf

The sixth beneficiary on the Chelsea River, Mobil, is located below the Chelsea St. Bridge. Although there are five beneficiaries upstream of the bridge there are only three active terminals. Gibbs and Global co-own one receiving facility. Northeast currently leases Belcher's terminal and pipes oil over to their storage tanks which are also leased. Northeast until 1988 had leased storage and receiving facilities from ARCO. ARCO is currently attempting to sell this facility. As of this writing, there were no serious prospective buyers of the property. Gulf owns and operates their own receiving dock.

Downstream of the Chelsea, Amerada Hess owns a facility which has been inactive for the past three years. They are currently evaluating reentry into the Boston market with a decision due the end of the summer of 1988. They have indicated that the depth of the channel would effect the size of ship used to bring in petroleum products. Belcher operates a facility below the bridge, but they have limited storage capacity, so that it is unlikely that Belcher would benefit from channel improvement.

Terminal operators interviewed by NED have indicated a desire to use deeper draft vessels if additional depth were available. The change in size distribution of the fleet based on the interviews is shown in Tables 3-14 through 3-19 under the channel options of 38 and 40 feet. Data from the WCSC indicates that approximately one-third of the petroleum coming into Boston arrives by way of barge, while the remaining two-thirds arrives on tankers. Typical vessel dimensions and operating costs are provided in Tables 3-11 and 3-12, respectively.

The major ports of origin of petroleum products for project beneficiaries are summarized below by channel as provided by terminal operators.

	Carribean	Gulf Coast	NY-NJ-PA	Total*
Mystic	750,536	604,350	829,139	3,020,779
Reserved	1,113,935	680,246	352,060	2,146,241
Chelsea	1,242,784	920,225	3,911,025	6,252,093

*Total includes other ports of origin.

Terminal operators at Boston indicate that storage capacity and berthing facilities are both adequate for vessels of slightly larger dimensions. Various shipping interests indicate that the maximum size vessel which would call on Boston would be a 70 to 80,000 DWT ship, depending on the extent to which the main channel is improved. It is felt that utilization of vessels larger than that would generally not occur because storage capacity and dock facilities do not appear to be adequate for ships of this size. At this point in time, there are no firm commitments to substantially expand and improve facilities to handle such ships.

TABLE 3-10
HISTORICAL RECORD OF TRIPS AND DRAFTS
OF VESSELS (INBOUND ONLY)
NUMBER OF TRIPS PER YEAR

Draft (Ft)	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	1974	1973	1972
41	-	-	-	-	-	-	-	-	-	3	1	2	1	-
40	3	4	3	1	2	5	20	30	19	12	15	15	18	16
39	7	5	2		4	20	26	40	36	41	41	25	56	41
38	-24	23	16	18	17	25	56	29	36	58	31	45	32	39
37	29	22	13	17	42	21	43	29	55	45	43	44	41	39
36	36	61	35	33	46	49	57	59	67	49	60	46	55	47
35	47	61	44	56	77	77	69	87	69	57	55	58	62	69
34	30	31	67	66	62	59	100	81	78	55	64	52	57	57
33	33	17	21	36	37	37	52	57	85	59	55	44	80	57
32	17	22	33	36	29	24	39	37	72	70	73	73	88	85
31	31	33	40	35	36	43	49	33	70	81	56	69	91	98
30	59	62	58	66	72	39	43	48	49	46	51	77	65	55
29	31	51	73	67	74	58	43	31	37	42	36	45	78	44
28	47	45	48	71	74	76	67	56	73	50	52	55	60	62
27	76	61	62	104	82	74	101	90	94	70	70	91	95	72
26	66	49	61	75	81	79	99	105	101	104	84	98	96	103
25	97	65	40	72	54	57	73	92	56	79	72	85	88	97
24	55	48	80	75	69	76	70	80	54	95	95	80	76	95
23	65	63	51	76	71	58	47	39	40	49	69	63	85	118
22	75	91	80	47	46	30	40	40	44	48	58	75	78	118
21	65	79	31	35	13	36	32	51	37	43	50	43	75	83
20	56	64	71	56	34	36	44	38	25	45	44	49	82	66
19	65	42	41	52	57	40	37	45	43	36	23	30	54	62
18 & less	5,885	5,034	4,936	5,050	7592	7157	8248	12,679	17,916	15,000	12,048	12,725	10,710	11,543
TOTAL	6,899	5,906	6,144	8671	8176	9455	13,876	19,156	16,237	13,246	13,989	12,223	13,066	

TABLE 3-11
TYPICAL VESSEL DIMENSIONS OF TANKER FLEET
BY TYPE AND DEADWEIGHT TONNAGE

Type	DWT	Length	Beam	Draft, Loaded
U.S. Flag Tankers				
	25,000	587	84	35
	35,000	660	84	35
	40,000	689	90	35
	50,000	736	102	40
	60,000	775	106	41
	80,000	811	116	42
Foreign Flag Tankers				
	20,000	544	79	30
	35,000	617	88	34
	40,000	600	106	36
	60,000	687	125	39
	80,000	763	144	40

Source: WRSC-IWR, barge companies

TABLE 3-12
TANKER HOURLY OPERATING COSTS

Vessel Size D.W.T.	Foreign Flag At Sea	Foreign Flag In Port	U.S. Flag At Sea	U.S. Flag In Port
20,000	$605	$467	1521	1236
25,000	691	500	1603	1313
35,000	725	528	1676	1382
40,000	760	550	1863	1554
50,000	819	573	1990	1643
60,000	880	595	2087	1688
80,000	957	633	2197	1760
90,000	1017	655	2286	1797

Source: 1988 WRSC-IWR data
NA - Not available

Cost of Commodity Movements

A typical computation of vessel voyage costs is shown in Tables 13a-13k. The methodology used allows for consideration of tidal delays, lightering and lightloading. Costs were developed averaging roundtrip distances from the chief ports of origin. The percentage of petroleum products barged from refineries is assumed to remain constant throughout the study period.

The projected fleet characteristics of vessels serving Boston Harbor are shown in Tables 3-14 through 3-19. The projected distribution of tonnage carried by size of ship is based upon 1983 vessel movement data provided by WCSC and interviews conducted with terminal operators. Average unit transportation costs are developed for each terminal by weighting each of the vessel size unit transportation costs by their relative proportions of tonnage carried. Separate estimates are developed for 1995 and the period 2000 through 2045. This covers the 50-year project life. The full adjustment to usage of larger ships is anticipated to be made by year 5 of the project.

Data on domestic shop movements was provided to NED by the WCSC. This information contains ports of origin and destination, terminals of origin and destination, loaded drafts, the type and volume of cargo, and a vessel identification numbers. Dimensions of vessels in the US fleet including tonnage design drafts and DWT were also obtained from the WCSC. In Table 3-13a tonnage was aggregated by trade route and size class for domestic ship movements for Terminal A (due to confidentality of the data actual terminals are not identified in the report.) The calculation of dollars per ton transportation cost by vessel size class (DWT) is shown in Table 3-13b. Hourly shipping costs and vessel operating speeds were provided by

Institute for Water Resources (IWR). The distance at sea is a weighted average of the different domestic trade routes served by each DWT class. In this case all tonnage carried in tankers originates in the Gulf Coast (Table 3-13a). The cost per ton calculations assumes that each vessel is fully loaded. Not all vessels that come into Boston Harbor are fully loaded. Some may off load a portion of their cargo at another port before proceeding to Boston, some shipments may be lightloaded, or there may be other reasons for ships arriving at Boston with less than a full load, such as the unavailability of smaller ships. Thus, unit costs are adjusted to account for lightloading, lightering and tidal delay.

In Table 3-13c, the per ton cost of using each size class is shown for Terminal A for the existing condition, 35 feet,and the proposed with project conditions of 38 and 40 feet. The per unit costs shown in Table 3-13c are the same as those in 3-13b. However, this need not be the case. Per ton costs in Table 3-13c will reflect tidal delays, lightloading and lightering which were not experienced by Terminal A in domestic trade.

In Table 3-13d the actual distribution of tonnage by DWT size class for 1983 is projected to occur in 1995, for the without project condition, which is the existing 35 foot channel. Discussions with terminal operators do not indicate a change in fleet mix overtime in the without project condition. The with project distribution is shown in the columns headed by 38 and 40 feet. The percentage of tonnage arriving at the terminal in vessels, fully loaded and drawing in excess of the channel depth (providing for underkeel clearance) was assumed to arrive in larger vessels under the with project condition. Underkeel clearance varied from terminal to terminal but was usually around three feet. In this example, there were no shipments using the channel to its fullest depth. Therefore, the distribution was the same with and without the project. The analysis covers a 50 year period, 1995 to 2045. The project was divided into two periods as it was expected that it would take shippers five years to adjust their fleet mix to the desired tonnage size distribution.

The percentage distribution under each channel depth is applied to the unit costs ($per ton) in Table 3-13c to determine a weighted average cost per ton over all DWT size classes projected to serve this terminal. The results are shown in the last two rows of Table 3-13c.

Similar calculations were made for the foreign fleet and are shown in Tables 3-13e through 3-13h. The unit costs for the foreign and domestic fleet are then weighted by their relative contribution to total tonnage carried to determine an overall unit cost for the terminal. This calculation is shown in Table 3-13i. Note in table 3-13g, how the limit costs derived in Table 3-13f, are modified to account for tidal delay and lightloading.

Table 3-13a
Terminal A Tonnage
Mystic River

	NY-NJ Tons	Gulf Coast Tons
Barges		
S		
M	40,959	
L		
tot.		
Tankers		
25		
35		4,524
40		
50		20,607
60		
total	40,959	25,131

Table 3-13b
Terminal A
Tanker Unit Costs
US Flag

	Vessel Size DWT, 000				
	25	35	40	50	60
Distance (ave)	4400	4400	4400	4400	4400
hrs at sea	275	275	267	267	293
$/hr at sea	1603	1676	1863	1990	2087
At sea cost	440,825	460,900	497,421	531,330	611,491
hr in port	24	24	24	24	24
$/hr in port	1313	1382	1554	1643	1688
In port cost	31,512	33,168	37,296	39,432	40,512
Total cost	472,337	494,068	534,717	570,762	652,003
Payload	26,880	37,632	43,008	53,760	64,512
$ ton	$17.57	$13.13	$12.43	$10.62	$10.11

Table 3-13c
Terminal A
Unit Cost by Channel
Depth, US Flag Vesses

Vessel DWT,000	Draft, ft.	Channel Depth, ft 35	38	40
60		10.11	10.11	10.11
50		10.62	10.62	10.62
40		12.43	12.43	12.43
35		13.13	13.13	13.13
25		17.57	17.57	17.57
Barges		2.01	2.01	2.01
ave				
1995		5.46	5.46	5.46
2000-2045		5.46	5.46	5.46

Note: Although barging is relatively less costly, transportation costs are only one element in the total cost of providing petroleum products.

Table 3-13d
Terminal A
Mystic River
Tonnage Distribution
by US Flag vessels, Percent

1995

Vessel DWT,000	Draft, ft.	Channel Depth, ft 35	38	40
60	41			
50	40	31	31	31
40	35			
35	35	7	7	7
25	35			
Barges		62	62	62

2000-2045

60	41			
50	40	31	31	31
40	35			
35	35	7	7	7
25	35			
Barges		62	62	62

Table 3-13e
Terminal A
Mystic River
FF Vessels

DWT	Draft	Tons
20,000	30	35,962
25,000	31	53,942
35,000	34	
40,000	36	251,732
50,000	37	
60,000	39	257,725
80,000	40	
90,000	45	
	Total	599,361

Table 3-13f
Terminal A
FF Tanker Unit Costs

Origin: Carribbean, 4400 miles
Speed: 16 knots
hours at sea: 275
hours in port: 24

	20,000	25,000	35,000	40,000	50,000	60,000	70,000	80,000
Hourly Cost								
At sea	605	691	725	760	819	880	912	957
In port	467	500	528	550	573	595	598	633
Payload	21,504	26,880	37,632	43,008	53,760	64,512	75,264	86,016
Draft	30	31	34	36	37	39	40	40
Trans Cost								
At sea	166,375	190,025	199,375	209,000	225,225	242,000	250,800	263,175
In port	11,208	12,000	12,672	13,200	13,752	14,280	14,352	15,192
Total	177,583	202,025	212,047	222,200	238,977	256,280	265,152	278,367
Cost/ton	8.26	7.52	5.63	5.17	4.45	3.97	3.52	3.24

Table 3-13g
Terminal A
Mystic River
Unit Cost by Channel Depth*
Foreign Flag Vessels

Vessel DWT,000	Draft, ft	Channel Depth, ft. 35	38	40
80	40	3.44[2]	3.42[2]	3.25
70	40	3.77[2]	3.74[2]	3.53
60	39	4.15[1]	4.12	3.98
50	37	4.49	4.46	4.45
40	36	5.21	5.17	5.17
35	34	5.65	5.63	5.63
25	31	7.52	7.52	7.52
20	30	8.26	8.26	8.26
Average				
1995		4.84	4.82	4.47 (4.75)
2000-2045		4.84	4.82	4.30 (4.45)

* 3' underkeel clearance

1) 1 foot lightloaded
2) 2 feet lightloaded

Table 3-13h
Terminal A
Mystic River
Projected Tonnage Distribution by
Foreign Flag Vessels, percent

1995

Vessel DWT,000	Draft,	Channel Depth, ft. 35	38	40
80	40			14
70	40			13
60	39	43	43	43
50				
40	36	42	42	15
35	34			
25	31	9	9	9
20	30	6	6	6

2000-2045

80	40			28
70	40			26
60	39	43	43	16
50				
40	36			
35	34			
25	31	9	9	9
20	30	6	6	6

Table 3-13i
Terminal A
Mystic Channel
Unit Cost by Channel Depth

1995

Channel Depth.

35': (.10 x 5.46) + (.90 x 4.84) = $4.90
38': (.10 x 5.46) + (.90 x 4.82) = 4.88
40': (.10 x 5.46) + (.90 x 4.47) = 4.57 (4.82)

2000 - 2045

35': (.10 x 5.46) + (.9 x 4.84) = $4.90
38': (.10 x 5.46) + (.9 x 4.82) = 4.88
40': (.10 x 5.46) + (.9 x 4.30) = 4.42 (4.82)

Table 3-3j
Terminal A
Mystic Channel
Transportation Cost by Channel Depth

	Channel Depth, ft			
	1995 - 590,000			
	35	38	40	
Cost per ton	4.90	4.88	4.57	(4.82)
Transportation Cost (000)	2,891	2,879	2,696	(2844)
Savings 000		12	195	(47)
	2000-2045 - 946,000			
Cost per ton	4.90	4.88	4.42	(4.82)
Transportation Cost (000)	4,635	4,616	4,181	(4,560)
Savings (000)		19	454	(75)
AAE (000)		$18	416	(71)

Table 3-13k
Terminal A
Mystic Channel
Benefits (000)
8-5/8, 50 years

38' Channel

a = $12
b = 1.4 x 11.1355 x .08765 = $1.4
c = 7 x 11.314 x .08765 x .6612 = 4.6
AAE = a + b + c = 12 + 1 + 5 = $18

40' Channel

a = $195
b = 51.8 x 11.1355 x .08765 = $50.6
c = 259 x 11.314 x .08765 x .6612 = 170
AAE = a + b + c = 195 + 51 + 170 = $416

Transportation Benefits

This section discusses the rationale for a change in the size distribution of the fleet in the with project condition. The change in fleet mix constitutes the major portion of the project benefit.

Project benefit results from a combination of more efficient use of vessels currently in service and the decision of shippers to use more of the larger vessels than they would with their channels at 35 feet MLW. From Table 3-13f we see that the cost per ton of oil shipped from the Caribbean on a foreign flag tanker drops to $4.45 on a 50,000 DWT vessels from $5.63 on a 35,000 DWT vessel. Thus using the larger vessel results in a 27 percent decrease in transportation costs. In the project channels shippers cannot make the full adjustment to the use of larger ships because of the channel depth of 35 feet which precludes the use of foreign flag vessels greater than 35,000 DWT without incurring some operating inefficiencies.

In order to use the larger ships now, shippers have to ride the tide, lighten their vessels before entering the main ship channel or lightload the vessels from the port of origin. Shippers also engage in two-porting, or scheduling a stop in a deep draft port such as New York where part of cargo is off-loaded. The balance of the cargo is then shipped to Boston. Deepening the project channels will reduce these inefficiencies and allow shippers to employ larger vessels. However, the employment of larger ships is not as extensive as it would be if the project channels had greater depth. The inefficiencies of using larger ships is partially captured in the analysis in terms of quantifying tidal delay costs, lighterage and lightloading.

Tidal delays are calculated based on mean high tide of an additional nine feet. However, there is much variation around the mean with high tide amounting to only an additional seven feet in some cases. Thus, our analysis understates the amount of tidal delay in terms of idle labor and equipment on ship. There are additional delay costs that are difficult to quantify. Shippers pay demmurage when vessels are not returned on time. Demurrage is a penalty cost for not using a ship in a specified period of time. A shipper is granted a normal time for sailing and offloading. When this time limit is exceeded penalty costs need to be paid to the ship's owner to compensate him for the opportunity cost of his equipment. Distrigas cites demurrage costs of $65,000 per day. (See Distrigas letter.) Similarly, for company owned ships, if they are delayed on one trip then they are delayed on successive port calls that they are scheduled to make for the year. This forces supply departments to incur the cost of chartering non-company vessels.

Shippers scheduling vessels based on minimum high tides will not schedule US flag vessels greater 40,000 DWT and foreign flag vessels grater than 50,000 DWT. These vessels would be too large to safely transit the project channels at the current depth of 35 feet.

Shippers scheduling vessels based on minimum high tides will not schedule US flag vessels greater than 40,000 DWT and foreign flag vessels greater than 50,000 DWT. These vessels would be to large to safely transit the project channels at the current depth of 35 feet.

Lightering increases the time to off-load a tanker. There also may be additional delays due to the availability of barges. Some of the terminals do not have separate off-loading facilities for barges and tankers. Thus the barge will need to wait for the tanker to offload thereby incurring demurrage costs to the shipper.

Lightloading is the most inefficient of all the operating practices adopted by shippers to bring in vessels with drafts in excess of the project channel depth. As can be seen by looking again at Table 3-13f, the per trip cost of a 50,000 DWT vessel is 13 percent higher than that of a 35,000 DWT. As you reduce the cargo carried by the larger vessels the per ton cost will rise eventually eliminating the benefits of using a larger vessel.

Another consideration that makes riding the tides and lightering unattractive that is also difficult to quantify, is increased risk of accidents from groundings and off loading of oil from tankers to barges. Severe weather conditions combined with insufficient under keel clearance may result in damage to ships and possible loss of life and cargo. Off loading oil at sea may be difficult in heavy seas with increased risk of an oil spill.

The costs and safety aspects of tidal delays, lightering and light loading do not preclude the use of large vessels with design drafts greater than the project channel depths. This can be seen by referencing tables 3-14 through 3-17 where vessels with design drafts in excess of the project channel depths are currently in use in the without project condition, which is a channel depth of 35 feet. However, the channel depth does limit the use of larger vessels because of the operating inefficiencies cited above. These inefficiencies are only partially quantified in the analysis. In interviews conducted by NED, terminal operators referenced these inefficiencies as limiting the use of larger vessels. The intention of shippers to use larger vessels when the restriction of channel depth is eased is documented in letters received from them (see letters attached). A current example of this is in the port of Providence, RI. Following the deepening of the Providence main ship channel to a depth of 40 feet, Mobil has decided to use 80,000 DWT vessels drafting 40' fully loaded to service their facility in the port. There is an upper limit to the extent that shippers can shift to larger vessels to take advantage of the economics of scale of these vessels. On shore storage capacity would probably make it unlikely that any vessels in excess of 80,000 DWT carrying petroleum would call on Boston.

The terminal unit transportation cost is combined with the anticipated tonnage for the terminal over the project life to determine transportation cost with and without the project. This calculation is shown in Table 3-13j. Benefit is the cost saving obtained by using larger ships, reducing tidal delay, lightering, and lightloading. It is the difference in cost with and without the project. The annualization of benefits is shown in Table 13k. The benefit stream is annualized using an interest rate of 8-5/8 percent over the 50 expected life of the project. Tables 3-13a through 3-13k are developed for each terminal. Benefits by channel are determined by aggregating benefits for each terminal in the channel. These benefits are shown in Tables 3-20 through 3-22 for each channel.

The petroleum products forecast shown in Table 3-6 is used to develop projections of future commodity flows for each terminal. If terminal operators indicated no major changes in activity over their immediate future then it was assumed that volumes received would change at the same rate as those projected to be received in Boston Harbor. With two exceptions all beneficiaries received petroleum products, mainly gasoline, residual and distillate oil. The non-petroleum receiving terminals export scrap metal, and receive container traffic. It is anticipated that the annual volume of exports and imports over the life of the project will be similar to current levels. Containerized traffic growth is based on a study conducted by Massport.

TABLE 3-14
RESERVED CHANNEL
TONNAGE DISTRIBUTION BY VESSEL SIZE,
FOREIGN FLAG TANKERS, PERCENT

VESSEL DWT (1,000)	DRAFT (Feet)	CHANNEL DEPTHS (Feet) 35	38	40
			1995 - 12	
70	40			12
60	39	30	30	30
50	37	47	47	35
40	36	21	21	21
35	34	2	2	2
			2000 - 2045	
70	40			24
60	39	30	30	30
50	37	47	47	23
40	36	21	21	21
35	34	2	2	2

TABLE 3-15
RESERVED CHANNEL
TONNAGE DISTRIBUTION BY VESSEL SIZE,
U.S. FLAG TANKERS, PERCENT

VESSEL DWT (1,000)	DRAFT (Feet)	Channel Depths (Feet) 35	38	40
			1995	
60	41	4	4	13
50	40	5	5	17
40	35	22	22	13
35	35	24	23	19
25	35	26	26	18
Barges		20	20	20
			2000 - 2045	
60	41	4	4	19
50	40	5	5	23
40	35	22	28	6
35	35	23	23	13
25	35	26	20	19
Barges		20	20	20

TABLE 3-16
MYSTIC RIVER
TONNAGE DISTRIBUTION, BY VESSEL SIZE,
FOREIGN FLAG TANKERS, PERCENT

VESSEL DWT (1,000)	DRAFT (Feet)	CHANNEL DEPTHS (Feet) 35	38	40
			1995	
80	40	18	18	22
70	40	0	0	16
60	39	36	36	27
50	37	33	33	22
40	36	0	0	0
35	34	0	0	0
25	31	7	7	7
20	30	5	5	5
			2000 - 2045	
80	40	18	18	26
70	40	0	0	13
60	39	36	36	20
50	37	33	33	22
40	36	0	0	0
35	34	0	0	0
25	31	7	7	7
20	30	5	5	5

TABLE 3-17
MYSTIC RIVER
TONNAGE DISTRIBUTION BY VESSEL SIZE,
U.S. FLAG TANKERS, PERCENT

VESSEL DWT (1,000)	DRAFT (Feet)	CHANNEL DEPTHS (Feet) 35	38	40
		1995		
60	41	0	0	5
50	40	16	16	21
40	35	5	5	6
35	35	12	12	7
25	35	10	10	5
Barges		57	57	57
		2000 - 2045		
60	41	0	0	9
50	40	16	16	21
40	35	5	5	5
35	35	12	12	6
25	35	10	10	2
Barges		57	57	57

TABLE 3-18
CHELSEA RIVER
TONNAGE DISTRIBUTION BY VESSEL SIZE,
FOREIGN FLAG TANKERS, PERCENT

VESSEL DWT (1,000)	DRAFT (Feet)	CHANNEL DEPTHS (Feet) 35	38	40
			1995	
50	39	0	0	
40	36	15	19	24
35	34	85	81	76
25	31			
			2000 - 2045	
50	39	0	0	
40	36	14	25	38
35	34	86	75	62
25	31			

TABLE 3-19
CHELSEA RIVER
TONNAGE DISTRIBUTION BY VESSEL SIZE,
U.S. FLAG TANKERS, PERCENT

VESSEL DWT (1,000)	DRAFT (Feet)	CHANNEL DEPTHS (Feet) 35	38	40
		1995		
	41	0	0	0
50	40	3	3	5
40	35	6	6	7
35	35	19	19	15
25	35	3	3	3
Barges		69	69	69
		2000 - 2045		
	41	0	0	0
50	40	3	3	5
40	35	6	6	8
35	35	19	19	16
25	35	3	3	4
Barges	35	69	69	69

TABLE 3-20
RESERVED CHANNEL
PETROLEUM PRODUCTS
TRANSPORTATION COST

	Channel Depth (Feet) 35	38	40
	1995 - 1,921,000 s.t.		
Cost per ton ($)	6.49	6.44	5.99
Transportation Cost (1,000)	12,466	12,363	11,507
Savings (1,000)		103	959
	2000 - 2045 - 2,147,000 s.t.		
Cost per ton ($)	6.33	6.27	5.67
Transportation Cost (1,000)	13,580	13,969	12,164
Savings (1,000)		111	1,416
AAE (1,000)		110	1,347

TABLE 3-21
MYSTIC RIVER
PETROLEUM PRODUCTS
TRANSPORTATION COST

	CHANNEL DEPTH (Feet)		
	35	38	40
	1995 - 3,217,000 s.t.		
Cost per ton ($)	5.70	5.68	5.31
Transportation Cost (1,000)	18,340	18,265	17,086
Savings (1,000)		75	1,254
	2000 - 2045 - 3,181,000 s.t.		
Cost per ton ($)	5.69	5.67	5.16
Transportation Cost (1,000)	18,114	18,041	16,426
Savings (1,000)		73	1,688
AAE (1,000)		73	1,624

TABLE 3-22
CHELSEA RIVER
PETROLEUM PRODUCTS
TRANSPORTATION COST

	CHANNEL DEPTH (Feet)		
	35	38	40
	1995 - 6,909,000 s.t.		
Cost per ton ($)	4.39	4.32	4.27
Transportation Cost (1,000)	30,327	29,815	29,519
Savings (1,000)		512	815
	2000 - 2045 - 7,209,000 s.t.		
Cost per ton ($)	4.42	4.33	4.26
Transportation Cost (1,000)	31,851	31,231	30,729
Savings (1,000)		620	1,122
AAE (1,000)		602	1,041

Project Use With and Without Improvements

Petroleum product receipts in Boston Harbor may decrease over the project life with a shift in demand away from residual and distillate fuels. This decline in petroleum products may be offset somewhat by growth in the importation of bulk dry products such as lumber, sugar, scrap metal and coal. However, with the exception of scrap metal exports, these products are carried in barges or shallow drafted vessels that can easily negotiate the current depths of Boston Harbor. Containership traffic is anticipated to grow over the study period, but benefits are not taken on this traffic as a depth greater than 35' is not required for this traffic.

Economic Justification

To be considered economically justified, a project must have a benefit/cost ratio of one or greater. Each segment of a project must be justified separately. These ratios for the Reserved Channel, the Mystic River Channel, and the Chelsea River Channel are displayed in Table 24 for each dredging depth option.

For purposes of analysis the Chelsea River Channel is further divided into two parts by the Chelsea Street Bridge. This structure currently imposes a channel width limitation of 96 feet. The city of Boston has indicated plans to increase the bridge width to 100 feet. As can be seen by referencing Table 3-11 vessels that draw in excess of 35 feet typically have beams greater than 100 feet. However, vessels sufficient in number should be available to take advantage of the with project increased depth, and not be constrained by the channel width at this point.

Project Benefit

Project benefit is the difference in transportation costs with and without the project. In Tables 3-20 through 3-22 transportation costs are aggregated by channel for petroleum products shippers.. The without project condition is the 35-foot channel, while the 38 and 40 foot channels represent the with project condition. There are two major types of benefit - 1) reduction in operating costs to the existing fleet serving Boston Harbor 2) economies of scale from a change in fleet mix with more larger vessels calling on Boston. Improving the current channel to 38 feet will result primarily in the first type of benefit whereas with deepening to 40 feet the primary benefit will be the second type. Reduced operating costs will result because of less tidal delay and reduced levels of lightloading and lightering. Tables 3-23 through 3-25 show the distribution of benefits within each channel by each terminal.

Table 3-23
Reserved Channel
Project Benefits
(000)

	38'		40'	
1. Boston Edison				
Operating Efficiencies	59		90	
Fleet Mix	0		984	
Total	59		1,074	
2. Belcher				
Operating Efficiencies	51		64	
Fleet Mix	0		253	
Total	51		317	
3. Sea Land				
Operating Inefficiencies	1,565		1,677	
Total				
Total				
Operating Efficiencies	1,675	(100%)	1,831	(60%)
Fleet Mix	0		1,237	(40%)
	1,675	(100%)	3,068	(100%)

Table 3-24
Mystic River
Project Benefits
(000)

	38'	40'
1. Boston Edison		
Operating Efficiencies	18	71
Fleet Mix	0	334
Total	18	405
1. Exxon		
Operating Efficiencies	48	198
Fleet Mix	0	1000
Total	48	1,198
3. Distrigas		
Operating Efficiencies	7	21
Fleet Mix	0	0
Total	7	21

4. Prolerized				
Operating Efficiencies	60		65	
Fleet Mix	90		114	
Total	150		179	
Total Mystic				
Operating Efficiencies	133	(60%)	355	(20%)
Fleet Mix	90	(40%)	1,448	(80%)
	223	100%	1,803	100%

Table 3-25
Chelsea River
Project Benefits
(000)

	38'	40'
Upstream of Chelsea St. Bridge		
1. Global		
Operating Efficiencies	40	60
Fleet Mix	39	90
Total	79	150
2. Belcher		
Operating Efficiencies	51	51
Fleet Mix	58	141
Total	109	192
3. Northeast		
Operating Efficiencies	42	56
Fleet Mix	64	213
Total	106	269
4. Gulf		
Operating Efficiencies	121	121
Fleet Mix	71	140
Total	192	261
Upstream Total		
Operating Efficiencies	254	288
Fleet Mix Change	232	584
Total	486	872
Downstream of Chelsea St. Bridge		
5. Mobil		
Operating Efficiencies	67	67
Fleet Mix Change	49	128
Total	116	195

Chelsea River Total				
Operating Efficiencies	321	(43%)	316	(33%)
Fleet Mix	281	(57%)	725	(67%)
	602	(100%)	1,041	(100%)

In total for all channls, 85 percent of the benefits at 38' would accrue without a change in fleet mix, whereas 42 percent of the benefits at 40 feet can be achieved with the same fleet.

Total Benefits (000)	38'		40'	
Operating Efficiencies	2,129	(85%)	2,502	(42%)
Fleet Mix Change	371	(15%)	3,410	(58%)
	2,500		5,912	

TABLE 3-26
TRANSPORTATION BENEFITS
($000)
MYSTIC RIVER CHANNEL

Channel Depth	1995	2000-2045	8-5/8% Average Annual Equivalent
35'	-	-	
38'	195	228	223
40'	1,394	1,873	1,803
42'			1,829

RESERVED CHANNEL

Channel Depth	1995	2000-2045	8-5/8% Average Annual Equivalent
35'	-	-	
38'	1,668	1,676	1,675
40'	2,636	3,093	3,068
42'			3,180

CHELSEA RIVER CHANNEL

Channel Depth	1995	2000-2045	8-5/8% Average Annual Equivalent
35'	-	-	
36'	61	65	64
38'	512	620	602
40'	815	1,122	1,041
	Downstream of the Chelsea St. Brdige		
35'	-	-	
36'	13	14	13
38'	93	121	116
40'	133	215	195
	Upstream of the Chelsea St. Bridge		
35'	-	-	
36'	48	52	51
38'	419	499	486
40'	682	907	846

TABLE 3-27
BENEFIT - COST RATIOS AND NET BENEFITS
MYSTIC RIVER CHANNEL

Channel Depth	Annual Benefits ($000)	Annual Costs ($000)	BCR	Net Benefits ($000)
35 ft. (Existing)	--	--	--	--
38 ft.	223	856	0.2	-633
40 ft.	1,803	1,260	1.4	543

RESERVED CHANNEL

Channel Depth	Annual Benefits ($000)	Annual Costs ($000)	BCR	Net Benefits ($000)
35 ft. (Existing)	--	--	--	--
38 ft.	1,675	280	5.9	1,395
40 ft.	3,068	729	4.2	2,339

CHELSEA RIVER CHANNEL

Channel Depth	Annual Benefits ($000)	Annual Costs ($000)	BCR	Net Benefits ($000)
35 ft. (Existing)	--	--	--	--
38 ft.	602	427	1.4	175
40 ft.	1,041	1,099	0.9	-58

COMBINED TRIBUTARIES

Channel Depth	Annual Benefits ($000)	Annual Costs ($000)	BCR	Net Benefits ($000)
35 ft. (Existing)	--	--	--	--
38 ft.[1]	602	427		175
40 ft.[2]	4,871	1,989		2,882
	5,473	2,416	2.2	3,057

1) Chelsea only
2) Excludes Chelsea

Benefits by commodity for the 40 foot channel in the combined plan are:

petroleum products	$4,043	72%
scrap metal	179	3%
container trade	$1,426	25%

Project Optimization

The plan that provides the largest net benefits is considered optimal. The plan that maximizes National Economic Development (NED) would require deepening the Reserved Channel and Mystic River to 40 feet MLW and the Chelsea River to 38 feet MLW. The determination of project optimization is shown in Table 3-28.

Table 3-28
Project Optimization (000)

	Channel Depth, Ft.		
	38	40	42
Mystic			
Benefit	223	1803	1829
Annual Cost			
Mystic	856	1260	1858
Main Channel (includes entrance)			
Broadsound North to Reserved Channel	N.A.	N.A.	260
Reserved Channel to Confluence	N.A.	N.A.	220,867
Total	856	1260	222,985
Net Benefit	-633	543	-221,156
BCR	0.2	1.4	0.0
Reserved			
Benefit	1675	3068	3180
Annual Cost			
Reserved	280	729	1069
Main Channel (includes entrance)			
Broadsound North to Reserved Channel	N.A.	N.A.	1482
Total	280	729	2551
Net Benefit	1395	2339	629
BCR	5.9	4.2	1.2
Chelsea	36	38	40
Benefit	64	602	1041
Annual Cost	100	427	1099
Net Benefit	-36	175	-58
BCR	0.6	1.4	0.9

Summary of Major Assumptions

Assumptions made in the analysis that affect the determination of transportation costs (and thus benefits) with and without a project are summarized below:

1. The base year was 1983. Tonnages by trade routes by size of ship were determined based on 1983 WCSC data for domestic movements while data obtained from Massport and the terminal operators supplement WCSC data for foreign movements. In the with project condition, i.e., 35' channel, the distribution of tonnage by trade route and size of ship is the same over the fifty year period 1995 to 2045, as in 1983. Some adjustments were made as a result of interviews with shippers. Shifts in origin of petroleum products affect transportation costs as these costs are a function distance carried and ownership of vessel. Transporting petroleum on foreign vessels is less costly than on U.S. flag vessels.

Referring back to Table 5, foreign imports as a percentage total commence in 1983 was approximately 32 percent. On average, foreign imports comprised approximately 30 percent of total commerce over the period 1972 to 1984. However, foreign imports increased to 50 percent of total commerce in 1986. Unit costs were adjusted to reflect the shift in tonnage to foreign vessels.

2. In the with project condition (channel depths of 38 and 40 feet) the percentage of tonnage carried by barges is assumed to remain constant. Terminal operators have indicated that they would use larger ships if additional depth was available. Tonnage that came into port fully loaded drafting greater than the channel limit (allowing for underkeel clearance) in 1983 was assumed to be shifted to larger vessels. Looking at Table 10 it can be seen that 1983 is typical for the last five years regarding the number of vessels drafting in excess of the channel limit of 35 feet.

3. Expected volumes of petroleum products shipped into Boston where determined for NED for 1990, 1995 and 2000. Anticipated petroleum volumes were held constant after the year 2000. Each terminals product mix is assumed to be the same over the study period as it was in 1983. Volumes by type of petroleum product are assumed to change at the same rate for the terminal as for the port of Boston as a whole. There is no intraport shift in volumes of petroleum products.

Sensitivity Analysis

Sensitivity analysis may be used to test the sensitivity of estimated project benefit to forecasts of future levels of variables that project benefit is dependent upon. Such variables include consumption levels of products shipped, the port of origin of these goods, the size distribution of the fleet carrying the goods and the operating characteristics of the shippers. Forecasts of these variables are made over the project life (50 years). The forecasts are based on past trends, current operating

procedures, expert information, published reports and industry outlook. Although forecasts are made on the best information possible, they are subject to error due to uncertainty - the future is unknown.

The first analysis tests the sensitivity of project benefit to forecasts of future shipments into Boston Harbor. The second analysis determines the payback period. The period of analysis is 50 years. Usually uncertainty increases with the length of the planning period. The payback period is the number of years needed to recapture the first construction cost. All other things equal, it is desirable to have a short payback period because of increased uncertainty associated with long planning periods.

Projected Tonnage

Uncertainty exists in projecting future volumes of oil to be consumed in the Boston area. An increase in the relative price of home heating oil will eventually result in a switch by residential users to other fuels. Utilities, since the oil price shocks of the 1970's, have been considering conversion from oil to either gas or coal for the generation of electric power. As the future price of gasoline increases consumers will purchase more fuel-efficient automobiles or reduce the number of miles driven with current automobiles. In short, an increase in the price of oil products will reduce the demand for those products. This section explores the effect of a decrease in consumption of oil products on the benefit cost ratio. Project benefits, costs and anticipated volumes for a 40 foot improvement project are shown is Table 29.

Table 3-29
NED Plan (000)
(Excludes Non-petroleum products)

	Reserved 40'	Channel Mystic 40'	Chelsea 38'
Tonnage, 000 st	1,921	3,217	6,909
Annual Benefit	1,347	1,624	602
Annual Cost	706	1,237	427
Net Benefit	641	387	175
B/C Ratio	1.9	1.3	1.4

In Table 30 tonnages anticipated to be shipped over the project life by beneficiaries is allowed to decrease to the point where the project still has a benefit-cost ratio greater than 1. Thus projected volume could decline by approximately 47 percent in the Reserve Channel, 23 percent in the Mystic River and 31 percent in the Chelsea River with net benefits for each project segment equal to zero. It is apparent that all other things equal it would take a large decrease in annual consumption of oil products over the life of the project to make the project economically infeasible.

Table 3-30
Sensitivity Analysis
NED Plan (000)
(Excludes non-Petroleum Products)

	Reserved	Channel Mystic	Chelsea
Tonnage, 000 S.T.*	1,009 (-47%)	2,474 (-23%)	4,744 (-31%)
Annual Benefit	706	1,237	427
Annual Cost	706	1,237	427
Net Benefit	0	0	0
B/C Ratio	1.0	1.0	1.0

* Number in parentheses represents percentage decline over anticipated volumes over the project life

Payback Period

The payback period is the length of time required to recover the first cost of the investment from the net cash flow produced by that investment for an interest rate equal to zero. The first cost of the Boston Harbor deepening project is estimated to be $24,500,000, including non-Federal costs such as berthing and deepening and utility relocations. The net cash flow can be defined as the difference between annual benefit and annual OM cost. Annual benefit is estimated to be $5,473,000 and annual OM is estimated to be $105,000 Thus net cash flow is $5,368,000 annually. The initial investment will be recouped in five years or the payback period is five years.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
400 RALPH PILL MARKETPLACE
22 BRIDGE STREET
CONCORD, NEW HAMPSHIRE 03301-4901

Colonel Thomas A. Rhen
Division Engineer
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254

MAY 11 1988

Dear Colonel Rhen:

A draft feasibility report and environmental assessment for the modification of the existing navigation project in Boston Harbor, Massachusetts was provided to us on February 26, 1988. We had been earlier advised that the draft would be available by early January 1988, with our comments due by mid-February. Mr. Ron Joseph had been assigned to this project but resigned and his last day was the same day that we received the draft. His replacement will report in early June. We apologize for our delay.

Our principal issue is the continual disposal of dredged material at the Boston Foul Area, without full comparison of all disposal alternatives and consideration of cumulative impacts. The Fish and Wildlife Service has participated in the interagency coordination for several years studying disposal problems at the Foul Area. Therefore, we continue to remain concerned that polluted sediments will not be adequately contained within the Foul Area. There are indications that fine grained non-cohesive materials are being dispersed into the Massachusetts Bay environment.

Previous use of the Foul Area should not eliminate an explanation of all disposal alternatives in the environmental assessment (EA). The EA is deficient because it relies primarily on engineering cost and convenience. Deferring bioassay/bioaccumulation testing until the post authorization studies implies that the Foul Area is acceptable without reservation. We also question how a benefit/cost ratio can be developed for project authorization without full considerations of all cost and environmental constraints on spoil disposal.

The EA does not adequately address cumulative impacts to the Foul Area. The proposed improvements to Boston Harbor will require the disposal of about 2.3 million cubic yards of material presumably at the Foul Area. In addition, some of the 8 million cubic yards of dredged and excavated material for the Central Artery/Third Harbor Tunnel Project could also be considered for disposal there, as well as the many private maintenance dredging projects in the Boston Harbor/Mystic River/Chelsea River area.

Boston Harbor is among the most contaminated harbors in the United States, yet there is no containment facility for disposal of materials dredged from the harbor. Several researchers have reported fin rot and tumors in the harbor's

fish, while others have reported azoic conditions in sediments in certain reaches of the inner harbor. These toxic and carcinogenic sediments are widespread in the harbor. Disposal of these contaminated sediments in open ocean waters would clearly not comply with the Ocean Dumping Act's statement of congressional policy "...to prevent or strictly limit the dumping into ocean waters of any material which would adversely affect human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities." The adverse impacts that the Act seeks to prevent are presently occurring in the harbor because of the contaminants contained in sediments. Transporting of these of contaminants and related adverse impacts from the harbor to the open ocean will increase the area and resources affected. Containment in either upland or in shallow waters, such as accomplished by the Corps in the southern United States, will reduce the adverse effect cited above, and meet the intent of the Act.

The EA acknowledges that a containment facility for spoil disposal has been discussed by State and Federal agencies. However, the EA dismisses further discussion since no specific proposals for this alternative have been developed. We consider the current project as adequate reason for the Corps to develop sufficient cost and feasibility information on a spoil containment area for comparison with other alternatives.

It is not clear in the EA how the channel slopes will be created during the dredging. It appears that the material to be dredged will include sediments that have not been previously disturbed. We suspect that this sediment may contain a wide array of toxic contaminants. Deepening the channel to 40' in the inner harbor creates conditions favorable for anoxia (zero dissolved oxygen) due to salt and temperature stratification. Therefore, the existing uses by marine life could be precluded due to a lack of oxygen. These adverse impacts would need to be discussed.

We have also participated in the Interagency Committee for the Central Artery/Third Harbor Tunnel projects in conjunction with a supplemental EIS that is being prepared by the Federal Highway Administration (FHWA) to address certain issues. The disposal of approximately 8 million cubic yards of dredged and excavated material is a major issue in that study. Based on presentations at these Interagency Committee meetings, it appears that their supplemental draft EIS will be addressing issues similar in nature and scope. Also, there most likely will be waterfront development proposals to take advantage of the deeper channel. Therefore, the secondary development should be considered, much like the Federal Court ordered at the proposed Sears Island Marine Terminal. We recommended that the Corps defer further action until the supplemental EIS is completed. That study could then be referenced and this would allow full integration of all actions concerning disposal of polluted dredged sediments.

These comments are provided under authority of the Fish and Wildlife Coordination Act, National Environmental Policy Act, and related authorities, however, we feel that further coordination is desirable to address the spoil disposal issue and to develop a disposal strategy that satisfies the requirements of NEPA. In summary, we feel it is premature to submit this document to the Board of Engineers for Rivers and Harbors at this time.

Sincerely yours,

Gordon E. Beckett

Gordon E. Beckett
Supervisor
New England Area

BOSTON SAND & GRAVEL CO.

OVER SEVENTY YEARS OF SERVICE • 617-227-9000 169 PORTLAND STREET, BOSTON, MASS 02114

May 2, 1988

Thomas A. Rhen, Colonel
Corps of Engineers, NED
424 Trspelo Road
Waltham, MA 02254-9149

Dear Colonel Rhen,

I am writing to request that you consider extending your proposed Boston Harbor Improvement Dredging Project into the Island End River Channel.

Boston Sand & Gravel owns property and a dock at this location. We are severely limited as to the size vessel we can bring in due to the restricted draft in the channel. Our company would benefit greatly from a dredging program which would provide easier movement of larger vessels through the Island End River.

Thank you for your consideration. We stand ready to assist you should you need more information.

Sincerely,

Dean M. Boylan Jr.

Dean M. Boylan, Jr.
President

DMBJr./pmk

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203-2211

April 28, 1988

Colonel Thomas A. Rhen
Division Engineer
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

ATTN: Planning Divisions, Coastal Development Branch

Dear Colonel Rhen:

Thank you for providing for our review the Draft Feasibility Report and Environmental Assessment for the proposed modification of the existing navigation facilities in Boston Harbor, Massachusetts. This three inch report titled "Navigation Improvement Study, Feasibility Report and Environmental Assessment, Mystic River, Chelsea River and Reserved Channel" dated February 1988 undoubtedly contains a lot of important information concerning the proposed project and it's potential impacts.

Regrettably, we did not have sufficient staff to review the document in detail within the comment period. We have been briefed by your staff and agree with your proposed plan to do the required biological testing after the project is authorized. The following comments are provided for your information and consideration.

It is not possible to make a preliminary determination on the acceptability of the sediments for ocean disposal at the Foul Area Disposal Site at this time since we do not have the biological test results. Potential concerns are described below.

We understand the project involves a total of approximately 2.4 million cubic yards of dredging which would take approximately two years to complete if dredging and disposal occurred year round. This, however, may not be possible due to the potential need to apply time of year restrictions on the dredging activity to prevent adverse impacts to winter flounder and shellfish spawning.

Approximately 80% of the sediments are thought to be pristine blue clay and rock which would not contain elevated levels of contaminants. At least a portion of the remaining sediments, however, contain elevated levels of contaminants. Dredging and disposal of the fine grained sediments existing in the navigation

channels may present an environmental problem due to elevated levels of contaminants. We understand the Mystic River sediments sampled contain 3.0 ppm of PCB. It is likely, based on our past biological testing information, that sediments containing this level of PCB would cause a statistically significant accumulation in test organisms exposed to these sediments in a bioaccumulation test.

It is possible, therefore, that the proposed disposal at the Foul Area Disposal Site may not comply with the requirements of the Ocean Dumping Act and the London Ocean Dumping Convention. While it may be possible to manage sediment dredging and disposal to effectively isolate contaminates from biological availability, we are not convinced that this management strategy would work at the Foul Area Disposal Site (FADS) due to it's great depth. We will be evaluating this issue further in our upcoming Environmental Impact Statement on FADS designation. In addition, we are concerned that a portion of the fine grained sediments which contain the contaminants, would be suspended in the water column for long periods of time. This suspension of contaminants could increase the contaminant load of PCB's and probably an assortment of other contaminants such as PAH's in the water column and ultimately the marine sediments in a large area surrounding the disposal site.

We have also noted that according to page EA-16, the Chelsea River sediments contain 240 ppm of PCB. Unless this is a typo and was meant to be 240 ppb of PCB, the sediments would be considered to be a hazardous waste subject to regulation under the Toxic Substances Control Act (TSCA.) We suggest you check your data and correct this if necessary. Ocean Disposal would definitely not be permitted if the levels of PCB exceed 50 ppm.

We are also aware that sediments in the Reserved Channel upstream of the proposed dredging have been found to contain levels of PCB that exceed 50 ppm. Additional sediment sampling in the Reserved Channel may be needed to confirm that the "hot spot" of PCB has not moved downstream into the proposed dredge area.

We apologize that we are not able to provide additional comments or a detailed review of the document at this time due to the short review period and our lack of staff. If you have any questions and for further coordination please call Edward Reiner of my staff at (617) 565-4434.

Sincerely,

for David A. Fierra, Director
Water Management Division

Copies furnished see next page:

BOSTON
REDEVELOPMENT
AUTHORITY

Raymond L. Flynn
Mayor

Stephen Coyle
Director

One City Hall Square
Boston, MA 02201
(617) 722-4300

4 27 '88

Division Engineer
New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254-9149

Re: Boston Harbor Navigation Improvement Study
Feasibility Report and Environmental Assessment

Dear Sir:

The Boston Redevelopment Authority has reviewed the Feasibility Report and Environmental Assessment for the Boston Harbor Navigation Improvement Study and wishes to offer the following comments.

The proposed project consists of the deepening of the existing 35-foot deep Boston Harbor Federal channels in the Mystic River, Chelsea River, and the Reserved Channel and vicinity and in the Inner Confluence Area to 40 feet, the nonstructural realignment of the Federal Channel through President Roads, and the enlargement of the President Roads Anchorage from 350 to 420 acres. Approximately 2.4 million cubic yards of dredged material is proposed to be disposed at the Foul Area Disposal Site. Underwater blasting would be required to remove approximately 94,000 cubic yards of ledge. The purpose of the proposed project is to increase the navigational efficiency and safety of harbor operations and to reduce or eliminate tidal delays for larger vessels which are now more frequently in service. Implementation of the project would result in substantial economic benefits to the Port of Boston.

Without the improvement project, effective and efficient utilization of Boston Harbor is predicted to be reduced, causing shippers to consider other, more costly, shipping methods than presently used, such as increased use of lightering, or to avoid the port altogether. Growth and development of the port would be hampered. In addition, the anticipated future use of the harbor by vessels larger than those presently in use could increase the risk of a navigation accident. Such reduction in safety could result in significant adverse environmental impacts, including the potential for accidental oil spills since petroleum products are the primary commodities shipped through Boston.

According to the Environmental Assessment, the major

environmental impacts associated with this project include a potential for interference with anadromous fisheries migration, the removal of benthic infauna, resuspension of sediments, the release of contaminants, and burial during disposal. Proposed mitigation measures to minimize these impacts include a seasonal restriction for dredging in the various channels, the use of excavated rock for habitat creation, and sequential dredging/disposal to cap contaminants at the point of disposal. Based on an evaluation of these impacts, the Corps has concluded that the proposed project would not result in any significant adverse impacts requiring the preparation of an Environmental Impact Statement.

In our review of the report and the environmental assessment, we believe that the potential environmental impacts of the proposed navigational improvement project on water quality and marine resources have been adequately identified, are similar to the impacts resulting from previous dredging projects, and can be minimized through the implementation of the proposed mitigation measures. It is essential that the channel dredging be restricted to those months which would avoid adverse impact on the anadromous fisheries migration through the project area and that blasting, where required, occur only at those times of minimal finfish movements to minimize fish mortalities to the greatest extent feasible.

It is recognized, however, that much of the surficial sediment that would be dredged is polluted with elevated levels of PCBs and heavy metals and may be contaminated with other toxicants as well. Moreover, the acceptability of the material for disposal at the Foul Area Disposal Site has not yet been determined, since specific testing for bioassay/bioaccumulation of the dredged material contaminants has yet to be performed. Since existing sediment samples indicate that the material to be dredged often is Class III material, it may be too contaminated to be considered for open water disposal, even with the implementation of the proposed mitigation measures. Additional testing is necessary before a final decision can be made, and the results of the bioassay and bioaccumulation tests should be made available to the appropriate State regulatory agencies for review prior to this decision. To reduce the potential for detrimental impact on the biota of the Foul Area, upland disposal of the surficial sediments should be seriously considered. It is also recommended that sealed clamshell buckets be used for the dredging itself, in order to minimize the potential for turbidity generation, which can be quite high with this type of dredging.

Lacking from the environmental assessment is a schedule for the proposed work. During the next decade, considerable activity will be occurring in and around the Boston Harbor, the major projects being the Third Harbor Tunnel/Central Artery project and the construction of secondary treatment facilities at Deer Island. Both of these projects involve the construction of tunnels underneath the main shipping channel in the Inner Harbor.

The disposal of the excavate and dredged material from these and other harbor projects, estimated to total some 17.6 million cubic yards, at the Foul Area and possibly Spectacle Island will generate an extremely high volume of barge trips on the Inner and Outer Harbors. The Third Harbor Tunnel/Central Artery project is estimated to generate a maximum of 12 barge movements per day in the early 1990's, while the Deer Island treatment plant construction will generate an additional daily maximum of 18-20 barge and supply ship movements for materials transport and excavate removal. Added to this would be the estimated 1,500 barge trips generated by this navigation improvement project over a two-year period. These trips, together with the general harbor traffic and growing water transportation ferries and the substantial recreational boating that occurs during the summer months, could result in potential conflicts among this heavy traffic as well as the tunnel construction activities themselves. Therefore, it is essential that there be close coordination with the Massachusetts Water Resources Authority, the Massachusetts Department of Public Works, and the City of Boston to assure that any potential conflicts are avoided to the extent possible.

The environmental assessment indicates that excavated rock would be disposed in such a way as to create an artificial reef to increase habitat niches. It should be noted that rock fill for containment will be required for the Third Harbor Tunnel/Central Artery project. Should the schedule for the two projects allow, the reuse for the excavated rock for the Third Harbor Tunnel containment needs should be explored and may result in some beneficial economies.

Sincerely,

Paul Reavis
Assistant Director for
Engineering and Design Services

EVERETT CHAMBER OF COMMERCE, INC.

Shawmut County Bank Building
459 Broadway, Everett, Massachusetts 02149
Telephone (617) 387-9100

April 25, 1988

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Colonel Thomas A. Rhen
Division Engineer
New England Division
U.S. Army Corp of Engineers
424 Trapelo Road
Waltham, Mass. 02254-9149

Dear Colonel Rhen:

Please record the Everett Chamber of Commerce in favor of Congress appropriating the necessary fund to deepen the lower Mystic River Channel, Chelsea Creek and South Boston Reserve Channel from their present depth of 35 feet at (MLW) to a depth of 40 feet and proposed by the New England Division Corps of Army Engineers in reponse to resulutions of Congress.

In our judgement, the deepening of these channels will improve navigation and eliminate tidal delays, in addition to opening up new possibilities for future development and jobs in the area.

Cordially

Harry B. Coholan
Executive Vice President

HBC/ds

U.S. Department of Transportation
United States Coast Guard

Commanding Officer
U.S. Coast Guard
Marine Safety Office

447 Commercial Street
Boston, MA 02109-1096
Phone: (617)565-9000
FTS 835-9000

16600
APR 20 1988

U.S. Army Corps of Engineers, New England Division
Coastal Development Branch, Bldg 114 South
424 Trapelo Road
Waltham, MA 02254-9149

Dear Mr. Habel:

I have reviewed your Draft Feasibility Report For Navigation Improvements In Boston Harbor dated February 25, 1988 and offer the following comments:

Presently, a permanent Captain of the Port Safety Zone exists as per 33 CFR 165.120 to control vessel movement in the vicinity of the Chelsea Street Bridge in the Chelsea River. These regulations were designed to protect vessels and the Chelsea Street Bridge structure. Accordingly, to ensure safety, there are restrictions imposed on the size of vessels allowed to transit through this Safety Zone. The duration of this Safety Zone is uncertain due to the physical limitations of the bridge itself and its present state of disrepair.

In view of the above, deeper draft and larger sized vessels which could transit the Chelsea River upon dredging to -40 feet MLW will still be restricted from doing so because of the prevailing Safety Zone focused around the Chelsea Street Bridge. This limiting factor may directly impact the economic benefits obtained from deepening the Chelsea River. I therefore urge you to consult with the City of Boston regarding their future plans for modification of the Chelsea Street Bridge as this appears to be a critical issue.

If I can be of further assistance on this matter, please contact LT CORBIN of my staff at the above address or phone number.

Sincerely,

R. L. ANDERSON
Captain, U.S. Coast Guard
Captain of the Port

Copy: Commander, First Coast Guard District (m); (obr); (oan)
Boston Harbor Pilots

EDFC EVERETT DEVELOPMENT AND FINANCIAL CORPORATION
459 Broadway, Everett, Massachusetts 02149
Telephone (617) 387-9100

April 25, 1988

Colonel Thomas A. Rhen
Division Engineer
New England Division
U.S. Army Corp of Engineers
424 Trapelo Road
Waltham, Mass. 02254-9149

Dear Colonel Rhen:

The Everett Development and Financial Corporation is in favor of deepening the lower Mystic River in Everett.

The proposal to do so was requested by Congress and the study to do so has been completed by the New England Division Corps of Army Engineers.

As an organization established to expand the development of the Everett community we would consider an appropriation of Federal Funds by Congress to deepen the River a step ahead in the continued development of Everett as a port City.

Cordially

David J. Carlberg
President

DJC/ds

April 19, 1988

Thomas Rhen
Division Engineer
Army Corps of Engineers
424 Trapelo Rd.
Waltham, MA 02254-9149

RE: Deep-Draft Navigation Improvements to Boston Harbor, Draft Environmental Assessment, Boston and Chelsea

Dear Colonel Rhen:

Thank you for submitting a copy of the report referenced above to the Massachusetts Historical Commission. Staff of the MHC have reviewed the draft feasibility study and environmental assessment.

The project includes the Chelsea Street Bridge, which is considered to be eligible for listing in the National Register of Historic Places as the only surviving Strauss heel-trunnion bascule bridge in Massachusetts. Your proposal includes the replacement of the bridge's fender system to increase the existing 96-foot horizontal clearance to 100 feet. The MHC anticipates that your proposal will have no adverse effect (36 CFR 800.9) on the significant historic and engineering characteristics of the bridge, provided that the MHC is given the opportunity to review project design plans for the proposed bridge work.

These comments have been offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966 (36 CFR 800). A copy of this letter should be included with the documentation you submit to the Advisory Council on Historic Preservation, Old Post Office Building, 1100 Pennsylvania Ave., NW, #809, Washington, D.C. 20004.

If you have any questions concerning these comments, please feel free to contact Brona Simon or William Smith at this office.

Sincerely,

Valerie A. Talmage
Executive Director
State Historic Preservation Officer
Massachusetts Historical Commission

xc: ACHP
Marie Bourassa, ACE

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Habitat Conservation Branch
Sandy Hook Marine Laboratory
Highland, NJ 07732

April 5, 1988

Colonel Thomas A. Rhen
Division Engineer
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Col. Rhen:

We have reviewed the Draft Feasibility Report and Environmental Assessment (Report) for navigation improvements to Boston Harbor, Massachusetts. The proposed structural improvements involve deepening the Federal Channels in the Reserved Channel, the lower Mystic River, and the Chelsea River from 35 to 40 feet deep at mean low water, and disposing of approximately 2.4 million cubic yards of dredged material at the Foul Area Disposal Site (FADS) in Massachusetts Bay.

We do not object to the proposed dredging, but we are concerned with the proposed disposal of all of the dredged material at the FADS. About 80% of the dredged material consists of lean clay and rock, and should be acceptable for ocean disposal. However, previous dredging projects in Boston Harbor, as well as other published information regarding the quality of Boston Harbor sediments, show that some of the surficial dredged material will be unsuitable for ocean disposal. This Report indicates that the adverse effects of disposing the project's polluted sediments will be mitigated by capping with the cleaner dredged material. However, we have seen no information to indicate that capping is an effective management technique for sequestering contaminated sediments at the FADS. Unless the capping issue at FADS can be resolved prior to this dredging project, we recommend that the Corps investigate other disposal options for the 20% of the dredged material likely to be contaminated.

Endangered and threatened species that may occur in the disposal site area include the humpback whale, Megaptera novaeangliae, right whale, Eubalaena glacialis, fin whale, Balaenoptera physalus, sei whale, Balaenoptera borealis, leatherback turtle, Dermochelys coriacea, and loggerhead turtle, Caretta caretta. The impacts of disposal at FADS on endangered and threatened species are currently being assessed in the ongoing FADS site designation process. We cannot, at this time, concur with the Report's assumption that endangered and threatened species and their food sources will not be affected by disposal activities at FADS.

For further coordination regarding this project, please contact Susan Mello at (617) 548-5123 or Doug Beach at (617) 281-3600.

Sincerely,

Stanley W. Gorski
Assistant Branch Chief

BOSTON EDISON
800 Boylston Street
Boston, Massachusetts 02199

March 28, 1988

Division Engineer
New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Colonel Rhen:

On behalf of Boston Edison Company, I submit comments on the Draft Feasibility Report and Environmental Assessment for deepening existing navigation channels in the Mystic and Chelsea Rivers and the Reserved Channel. I congratulate you in the thoroughness and clarity of the draft report and thank you for the opportunity to review the proposed modifications. We would welcome an opportunity to meet with your staff as the project proceeds and to provide you with details you may require.

I would in the interim offer the following specific comments on your Recommended Plan of Improvement as they impact or have the potential to impact the Company.

1. Reserved Channel, South Boston, southside:

   a) On a copy of report Figure 34, I have indicated the approximate dividing line between existing Boston Edison Company property and our east boundary neighbor, the MBTA.

   b) Also indicated on that figure is an area in front of the New Boston Station screenwell structure, last dredged in 1976, which the Company has under consideration for future dredging. We would hope that the area could be considered in concert with your dredging. A 1974 plan and cross sections are attached.

   c) The Company also has a utility tunnel extending approximately northward from the New Boston Station adjacent to the "L" Street Bridge.

   d) The report references Boston Edison Company, as a "Beneficiary" and recommends that the south side of the channel be narrowed by some 15'±. As is planned for the northside, we would anticipate consideration of the structural integrity of bulkheads on the southside as well prior to dredging to 40' depth and of any deepening of berthing areas.

   e) Enclosed also is a plan indicating two proposed cable routes from the New Boston Station (on "L" Street) out to Deer Island to provide power for MWRA construction activities in a 1990-1991 timeframe.

2. Mystic River Channel:

   a) On a copy of report Figure 34, I have indicated on the north side of the river that Boston Edison property now includes that portion marked as "Belcher Petroleum".

   b) From the Mystic Station, a utility tunnel containing lines 250-517 and 329-511 is indicated approximately parallel to the Malden Bridge. A larger plan is available which provides more detail of the area. Lines 250-516, 329-510, 211-514 and a spare pipe are in the Mystic River.

   c) Boston Edison's Mystic Station outfall canal structure is presently under consideration for some repair/maintenance work. If the -40' MLW deepening of the river is bounded by the Federal Channel line, the present structure is considered to be sound. It is unclear presently what effect a berth deepening of -40 MLW right up to that bulkhead would have however.

3. Chelsea River:

   a) The report (page 60) references Company cables in need of burying 200 + 300' downstream of the Chelsea St. Bridge.

   b) Page 60 also references sixteen five-inch electrical conduits 2,800' ± upstream of the McArdle Bridge. Those are Boston Edison conduits but it is not clear that they would not be impacted by a deepening to -40' MLW.

4. Weymouth Fore River:

   a) This week the Company issued a Request for Proposal for the revitalization of our Edgar Generating Station on the Weymouth Fore River opposite the former Quincy Shipyard. It is anticipated that reuse of the Edgar site for up to 600 MW of power will be proposed over the next three to four months. I have enclosed two drawings: one a closeup of the site and the second indicating its location relative to Nantasket Roads.

   b) The question I would raise is whether you have any plans to deepen the Weymouth Fore River in view of the reuse of the Quincy Shipyard by the MWRA? We would be interested in any plans for deepening the river between the Fore River Bridge and Nantasket Roads.

In conclusion, thank you for this opportunity to comment on your recommendations for Boston Harbor. As your proposed project becomes finalized, we would welcome the opportunity to discuss details regarding our utilities and generating station waterfront structures. I can be reached at 424-2975 should you have any questions.

Sincerely,

Lillian N. Morgenstern

Lillian N. Morgenstern, Ph.D.
Principal Environmental Planner

INDEPENDENT CEMENT CORPORATION
POST OFFICE BOX 12-310
ALBANY, NEW YORK 12212
(518) 459-3211

March 28, 1983

Thomas A. Rhen, Colonel
Corps of Engineers, NED
424 Trapelo Road
Waltham, Massachusetts 02254-9149

Attn: Coastal Development Branch, Bldg 144 South

Re: Draft Feasibility Report
Navigation Improvements
Boston Harbor, MA

Dear Colonel Rhen:

We have reviewed the extent of the above referenced project and request that you consider extending the proposed program into the Island End River Channel (see attached sketch).

A six foot Federal Channel currently exists at this location but it is of insufficient depth to accomodate commercial vessels that dock at the Boston Sand & Gravel and Cold Water Seafood piers. Independent Cement Corporation has attempted to implement a dredging program at this location but has been hampered by regulatory requirements. To satisfy these requirements as a single commercial entity proves to be economically infeasible.

We recommend that you investigate the feasibility of widening and deepening the Federal Channel in the Island End River to assist the adjacent commercial operations in reducing shipping costs and to provide a service to the cities of Everett and Chelsea by cleaning up a contaminated river bottom. It is our understanding that the heavy metals and PCB's in the Island End River are the result of previous commercial (coal gasification) and governmental (World War II) activities in this area.

Adjacent commercial users that would benefit by this dredging and cleanup include the Exxon Corporation, Boston Sand & Gravel, Independent Cement Corporation, and Cold Water Seafood. The City of Everett would also benefit by this dredging if it was extended to their property lines.

In addition to the improved commercial benefit, the greatly improved water quality would affect all and contribute tremendously to the quality of the Boston Harbor waters.

We estimate that 20-50,000 yards of material needs to be removed from this area to provide a 30 foot deep (MSL) channel thru the Island End River.

Independent Cement Corporation alone would realize a $250,000 annual benefit from such dredging due to decreased cement shipping costs. This appears to be well within the project's benefit/cost guidelines

Please indicate anything we can do to assist you in extending your study into this active channel area.

Very truly yours,

Scott M. Horton
Project Manager
Independent Cement Corporation

Attachment

cc: Mayor McCarthy, City of Everett
Everett Conservation Commission
Boston Sand & Gravel
Cold Water Seafood
Exxon Corporation
City of Chelsea
Carlton Noyes, Jason Cortell Assoc.
Prolerizer of NE
Distrigas
J. O'Connell, Office of Coastal Zone Management
S. Congdon, C/E Regulatory Functions Branch
Dr. R. R. Pikul, P. E.

SMH/RRP/rys

New England Aquarium

Central Wharf
Boston, Massachusetts 02110-3399
(617) 973-5200

March 25, 1988

Thomas A. Rhen
Colonel, Corps of Engineers
Division Engineer, New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Colonel Rhen,

Enclosed are comments prepared by the New England Aquarium regarding the Boston Harbor Navigation Improvement Study, Draft Feasibility Report and Environmental Assessment.

Thank you for the opportunity to comment. If you have any questions about the points we raise, please feel free to call me at (617) 973-6552.

Sincerely,

Sharon Dean

Sharon Dean
Conservation Coordinator
New England Aquarium

SED
Enclosure

New England Aquarium
Central Wharf
Boston, Massachusetts 02110 3399
617 973 5200

NEW ENGLAND AQUARIUM

COMMENTS

Submitted to

The U.S. Army Corps of Engineers
New England Division

re:

NAVIGATION IMPROVEMENT STUDY
FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT
MYSTIC RIVER, CHELSEA RIVER AND RESERVED CHANNEL
Boston Harbor, Massachusetts

March 25, 1988

The New England Aquarium has reviewed the U.S. Army Corps of Engineers Draft Navigation and Improvement Study/Feasibility Report and Environmental Assessment for the Mystic River, Chelsea River and Reserved Channel, Boston Harbor, Massachusetts. We have several concerns regarding potential environmental impacts of the proposed project. We believe the Corps' "Finding of No Significant Impact" and determination that a full Environmental Impact Study should not be required, is unjustified. Contaminant data contained in the Environmental Assessment, and data gathered from other assessments made on sediments adjacent to or within the proposed dredge sites, indicate that these areas contain high levels of toxic compounds. A full Environmental Impact Study should therefore be required.

The proposed project would entail dredging approximately 2.3 million cubic yards of silt, clay and sand, plus an additional 90,000 cubic yards of fragmented ledge, and the disposal of these spoils at the Massachusetts Bay Foul Area Disposal Site (FADS).

The New England Aquarium's Edgerton Research Laboratory has conducted numerous studies in which Boston Harbor sediments have been analysed for both metal and organic contaminants. Two of these studies have a direct bearing on the Corps of Engineers' proposed dredging project. In an early work (New England Aquarium, 1972, Trace Metal Analysis of Boston Harbor Water and Sediments, Vol. II), exceptionally high concentrations of such metals as cadmium (3.3 to 10 ppm), copper (226 to 357 ppm), mercury (0.9 to 2.3 ppm) and lead (161 to 675 ppm) were measured in sediments from three stations in the Mystic River. In a more

recent study (New England Aquarium, 1982, Chemical Evaluation of Sediments from a Proposed Marina on Reserved Channel, South Boston, Massachusetts), high levels (Class III) of arsenic (24 to 34 ppm), nickel (679 ppm), mercury (1.7 to 10.8 ppm), lead (247 to 1176 ppm), and PCBs (1 to 34.5 ppm) were measured in one or several of the 13 sites sampled in the upper reaches of Reserved Channel (west of the Summer St. Bridge).

The contaminant concentrations reported in these two New England Aquarium studies are, in general, considerably higher than the concentrations reported in the Environmental Assessment portion of the Corps of Engineers' draft document (pp. EA-15 to EA-23; EA-1-2 to EA-1-9). Additional testing should therefore be conducted by the Corps of Engineers to determine whether sediments are in fact more contaminated than the draft document would imply.

Regardless of the precise levels of contamination, it is clear that these sediments are substantially contaminated, primarily with heavy metals and PCBs. This raises questions concerning the effects that the dredging will have on the resuspension of sediments, the degree to which metals and PCBs will be mobilized, the bioavailability of these metals and PCBs, and the resulting toxicity to critical life stages of commercially important finfish and shellfish, as well as the toxicity to benthic invertebrates. Bucket dredging, in contrast to more easily controlled suction dredging, may compound the problem of resuspension and bioavailability of toxics.

The Draft Environmental Assessment (p. EA-5B) states that the main environmental impacts that will be caused by the dredging are:

1) removal of benthic organisms and the short-term loss of benthic productivity;

2) masking of chemical signals essential for anadromous fish migrations; and

3) reduction in photosynthesis and associated primary productivity due to periods of high turbidity.

The Corps has concluded that all three of these impacts will be short-term and will only effect small local areas. Yet, no assessment has been made of the toxicity of the resuspended sediments to larval or juvenile stages of fish and shellfish, phytoplankton, zooplankton, or benthic invertebrates. Informa-

tion is lacking on spawning species, larval contribution to recruitment of fish, and on the importance of the dredge areas as feeding habitat for fish.

The Draft Environmental Assessment further states that there will be a minimal release of metals and pesticides into solution during dredging (p. EA-57). This conclusion is based on two studies disseminated as technical reports by the Corps of Engineers (Chen et al., 1976; Bulk et al, 1975). However, it is generally recognized that the speciation of metals in marine waters, especially in the pore waters of harbor sediments, is complex. In addition, the well-known association of PCBs and suspended particulates, and the rapid accumulation of particle-associated PCBs by marine organisms, suggest that the resuspension of harbor sediments during dredging may be a significant toxicological problem. In fact, the reported results of the elutriate analysis of the Reserved Channel, Mystic River and Chelsea River sediments (pp. EA-59 to EA-60) indicate that high concentrations of PCBs will be released during dredging, as well as significant quantities of metals, oil and grease.

Questions surrounding environmental impact of the dredging must be resolved. Bioassay, contaminant bioburden and metal speciation studies should be conducted in order to address this issue. We recommend such studies be made part of a detailed Environmental Impact Study on the proposed dredging project.

The Draft Environmental Assessment also concludes that the dredged material is "suitable" for disposal at the Massachusetts Bay Foul Area Disposal Site (FADS), although the report recognizes that further testing (bioassays and bioaccumulation studies) will be necessary to substantiate this assumption. While the disposal of the material at the FADS will probably be of less environmental impact than the actual dredging, the sheer magnitude of the amount of dredge spoils that will be disposed of is of concern.

The Draft Environmental Assessment states that approximately 3 million cubic yards of dredge material were deposited at the FADS between 1975 and 1986 (p. B4). The proposed addition of 2.3 million cubic yards of contaminated dredge spoils over a two-year period reinforces the need for conducting proper bioassays and contaminant bioburden studies.

Precisely what will be the fate and effects of the dredge spoils on the FADS? Will capping be effective in containing the dredge material? Might it be redistributed to other parts of

Massachusetts Bay? These very important questions should be addressed.

In summary, the New England Aquarium believes the Draft Environmental Assessment does not sufficiently evaluate the possible toxic effects of sediments that will be resuspended during the two years of dredging, or the effects of disposal of dredged material at the Mass. Bay Foul Area Disposal Site. Bioassay, bioaccumulation and metal speciation studies should be begun as soon as possible. As well, more detailed analysis of physical and oceanographic processes operating at the Foul Area Disposal Site, and investigation into whether any capping of contaminated sediments would be effective, should be conducted. At the very least, we recommend that these studies be incorporated into the "Scope of Work" for a full Environmental Impact Study on the proposed dredging project.

The Environmental Protection Agency is presently completing the "Scope of Work" for an Environmental Impact Study on the proposed official designation of the FADS as an open water ocean disposal site for Boston Harbor sediments. In addition, the Mass. Office of Coastal Zone Management is proposing that a Generic Environmental Impact Report (GEIR) be done on the question of official designation. The GEIR would address the question of dredging need, the quantities of material to be dredged and disposed, the quality of the material, dredging methods, and alternative disposal sites. The Corps of Engineers' proposal to dredge the Chelsea River, Mystic River and Reserved Channel, and to dispose of the highly contaminated sediments at the FADS -- prior to completion of these comprehensive studies -- is premature. Dredging should be contingent upon the results of these studies.

Thank you for consideration of these comments.

Sharon Dean
Conservation Coordinator

William Robinson, PhD
Senior Scientist

New England Aquarium

SED/WR
cc: John Prescott, Executive Director, New England Aquarium
Paul Boyle, Director of Programs and Exhibits/General Curator, New England Aquarium

Bostongas

Charles P Buckley
Vice President
Engineering and Construction

Mr. Mark Habel, Project Manager
Department of the Army
Corp of Engineers, NED
424 Trapelo Road
Waltham, MA 02254-9149

ATTN: Coastal Development Branch
BLDG: 114 South

RE: Draft Feasibility Report and Environmental Assessment for Navigation Improvements at Boston Harbor, MA

Dear Mr. Habel: March 25, 1988

Thank you for your notice of February 25, 1988 concerning the Draft Feasibility Report and Environmental Assessment for Navigation Improvements at Boston Harbor, Massachusetts.

The draft report notes the existence of Boston Gas Company's 24" gas syphon located on the west side of the Chelsea Street Bridge under Chelsea creek at elevation minus 41 feet MLW. The report also notes that the syphon will have to be lowered to accommodate the proposed dredging of the creek.

The gas syphon is the sole source of gas supply to some 11,000 East Boston customers served by Boston Gas, including Logan Airport and so any project affecting the syphon is of considerable interest to Boston Gas.

We also note that the report estimates the potential cost of relocating the syphon at approximately $1,000,000. In order to perform a more detailed estimate for the relocation, more information about the details of the project in the vicinity of the syphon will be necessary. Boston Gas recently completed an expensive rebuilding of the fender system protecting the syphon. The impact of the proposed relocation on the recent work is not known but could add to the expense of the relocation. It is our belief, however, that the estimate cited in the draft report is an order of magnitude on the low side.

We would be happy to work with you to develop a more detailed estimate and will follow up with you to obtain the necessary information. We also expect that Boston Gas will be fully reimbursed for the expense associated with the relocation and request that you advise us how such reimbursement procedures can be initiated.

Future correspondence concerning this project should be addressed to:

Boston Gas Company
One Beacon Street
Boston, MA 0210B

ATTN: Charles P. Buckley
Vice President

Please be assured of our continued cooperation.

Very truly yours,

Charles P. Buckley

CPB:pl

The Commonwealth of Massachusetts
Executive Office of Transportation and Construction
Department of Public Works
99 High Street, 14th Floor, Boston, MA 02110

March 25, 1988

Division Engineer
New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Attention: Mr. Mark Habel, Project Manager

Subject: Boston Harbor Navigation Improvement Study Comments

Dear Sir:

We have reviewed your Feasibility Report and Environmental Assessment for Deep Draft Navigation Improvements to Boston Harbor from the perspective of our Central Artery/Third Harbor Tunnel Project and we offer the following comments.

Reference is made to our proposed Third Harbor Tunnel as a physical constraint to future deepening of the Main Ship Channel above the Marine terminal. The current design of the Third Harbor Tunnel includes the results of close coordination with the Corps of Engineers concerning proposed navigation channel improvements in the Main Ship Channel. As agreed with the Corps, the tunnel profile will include five feet of cover plus two feet of overdredge in order to accommodate a future 40-foot deep channel 1200 feet wide.

The proposed project as described in the Environmental Assessment states that approximately 2.4 million cubic yards of dredged material would be removed in 1500 barge trips over a two year period. Over the next ten years, the Central Artery/Third Harbor Tunnel Project plans to remove significant quantities of dredged and excavated material also by barge. As no specific schedule is presented in the Feasibility Report, it is not possible to determine whether there may be a potential for interference from barge movement operations. If the Corps determines that there may be a potential overlap in schedules, we would be ready to discuss any coordination that may be required.

Thank you for the opportunity to comment on the Feasibility Report.

Sincerely yours,

William V. Twomey
Director, I-93/I-90 Project

WVT/plh

The Commonwealth of Massachusetts
Division of Marine Fisheries
Leverett Saltonstall State Office Building
100 Cambridge Street
Boston, Massachusetts 02202
727-3193

PHILIP G. COATES
DIRECTOR

March 25, 1988

Col. Thomas A. Rhen
Division Engineer
New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Col. Rhen:

The Division has reviewed the draft Feasibility Report and Environmental Study for the modification of the existing Federal navigation projects in Boston Harbor, Massachusetts. The Division does not oppose the project, however, there are two major concerns relating to fishery impacts.

First we request that dredging be conducted so as not to impede or otherwise prevent anadromous fish including smelt, American shad and alewives from migrating to and from the Charles and Mystic Rivers on annual spawning runs. Secondly, we are concerned that certain toxics, namely PCBs and PAHs be sufficiently sampled in each of the proposed dredging areas to provide a representative characterization of the dredge spoils since sediments may contain excess amounts of these hydrocarbons so as to preclude disposal in the foul area disposal site.

In the event that toxics exceed EPA and state criteria for ocean disposal, alternatives must be included in the final report. The Division is also concerned that PAH levels may be sufficiently elevated in sediments at some locations to present problems with resuspension and bioaccumulation during and after both dredging and disposal relative to the fishery resources, particularly the lobster and winter flounder populations.

Sincerely yours,

W. Leigh Bridges (emg)
W. Leigh Bridges
Assistant Director

cc: Judy Pederson, CZM
R. Fairbanks, DMF

SSPORT, TEN PARK PLAZA, BOSTON MA 02116-3971, (617) 973-5500 TELEX 94-0365

March 25, 1988

Colonel Thomas A. Rhen
Division Engineer
USAED, New England
424 Trapelo Road
Waltham, MA 02254-9149

Dear Colonel Rhen:

The Massachusetts Port Authority staff has reviewed and concurs with the findings set forth in the draft copy of the Boston Harbor Navigation Improvement Study Feasibility Report and Environmental Assessment. It is our belief that the proposed channel modifications are needed and that they will confer important benefits not only to direct port users, but to the public-at-large as well. We were pleased, but not surprised, to see the very favorable benefit-to-cost ratio of 2 to 1.

The Massachusetts Port Authority does intend, within the limits of its Enabling Act and state law, to act as the local sponsor for the project once it is authorized by the U.S. Congress.

Massport has also reviewed the draft Local Cooperation Agreement and finds it acceptable in principle. There are portions of the draft agreement that we wish to study further and later discuss with you and your staff.

The Authority has noted the estimated construction cost of $22.7 million for the proposed improvements. We recognize that the non-federal share would amount to 35% of this cost; specifically $5.67 million payable before construction begins and $2.27 million which could be financed over 30 years. MPA understands that local interests would also be responsible for utility relocation.

I would like to thank you and the Corps of Engineers for perservering to complete this important effort.

Sincerely,

MASSACHUSETTS PORT AUTHORITY

David A. Davis
Executive Director

6854M

ICELANDIC FROZEN SEAFOOD

COLDWATER SEAFOOD CORPORATION

March 23, 1988

Thomas A. Rhen,
Colonel, Corps of Engineers
Division Engineer
New England Division,
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Mr. Rhen:

I am writing in response to your letter of February 25, 1988, in reference to the deepening of the existing navigational channels.

Our business is very dependent on products from the Faroe Islands, Iceland and other European countries that we receive on refrigerated vessels that discharge at our facility. There are several different vessels year round that utilize our facility, totaling 35 to 40 port calls per year, remaining in port from one to 4 days.

In addition, this channel is also extensively used by Exxon Corp. and Independent Cement Co.. The vessels calling at our facility, on occasion, have experienced delays due to the width and depth of the channel, especially when Independent Cement has a vessel at their facility.

I would like to suggest consideration be given to improving the Island End River Channel, at the same time as the proposed improvements are carried out.

Please advise what steps you suggest I take in order to have my proposal evaluated.

Sincerely yours,

Rick Gordon
Plant Manager

RG/mp

EVERETT CHAMBER OF COMMERCE, INC.

Shawmut County Bank Building
459 Broadway, Everett, Massachusetts 02149
Telephone (617) 387-9100

NEWS RELEASE

FROM: Everett Chamber of Commerce
Harry B. Coholan

March 22, 1988

The Everett Chamber today hailed the draft of a feasibility report and environmental assessment for navigation improvements at Boston Harbor and the Mystic River in Everett.

According to a study completed by the New England Division, Corps of Army Engineers in response to two resolutions passed by the U.S. Senate, the proposed improvement would deepen the lower Mystic River Channel, Chelsea Creek and South Boston Reserve Channel from their present depth of 35 feet at mean low water (MLW) to a depth of 40 feet. This was the best of several plans analyzed to meet the need of commercial port interest, according to the study.

The improvement would require the removal of approximately 2.3 million cubic yards of silt, clay and sand and 90,000 cubic yards of fragmented ledge at an approximate cost of $22.7 million dollars, of which the local sponsors share would be 35 percent, or $7.9 million. The Mass Port Authority has stated its willingness to be the project sponsor.

The harbor and river modification would reduce vessel operating cost by eliminating tidal delays for bulk cargo using larger ships, according to Harry B. Coholan, Chamber Executive Vice President and Director of the Island End Industrial Park in South Everett.

No money has yet been appropriated for the proposal and no starting date has been set according to officials.

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

COASTAL ZONE
MANAGEMENT

March 22, 1988

Col. Thomas A. Rhen
Division Engineer
New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254-9149

RE: Modifications to the Boston Harbor Federal Navigation Project

Dear Col. Rhen:

Governor Dukakis has asked that we provide comment to you regarding the proposed modifications to the Federal navigation project in Boston Harbor as described in the Feasibility Report and Environmental Assessment (FR/EA) dated February, 1988. As we recognize that this process will continue for a number of years and that the New England Division (NED) will, over that time, be actively seeking to coordinate their efforts, regarding this project, with the various relevant agencies of the Commonwealth, we will restrict the scope of our comments to general concerns and issues.

The two major areas of concern we have identified relate to the disposal of the dredged material that will be generated by the project and the project's economic justification. The basic assumption with regard to the disposal of the dredged material is that it will be suitable for disposal at the Foul Area Disposal Site. While we understand that the NED intends to collect this information over the next few years, and that it has available funds to initiate this work, we are concerned that other disposal options appear to have been eliminated from consideration. We feel that this decision is unjustified, especially in light of the additional information on the disposal of sediments from Boston Harbor that is currently being generated by the consultants for the Massachusetts DPW in support of the construction of the Third Harbor Tunnel. Should any portion of the material be shown to be unsuitable for ocean disposal, once the appropriate testing has been completed, the character of the project could be significantly altered. Given that the scaled-down version of the project includes some of the most contaminated areas in Boston Harbor, especially portions of the Mystic River, the potential exists for at least some of the dredged material to be found to be too contaminated for unconfined ocean disposal. In addition, while there has been some

indication that the most contaminated sediments to be dredged, may be capped, we have yet to be provided with any clear indication that capping can be effective at the Foul Area. In this light, it would seem that the NED should take a greater interest in examining other disposal options, including more active participation in the the ongoing efforts to identify an appropriate location for a confined disposal facility for contaminated dredged material in Boston Harbor, as a part of the subsequent planning for this project.

Our other major area of concern is the economic justification for the project. Given the length of time that has elapsed since the development of the document, the economic analysis seems to be somewhat out of date. For example, the petroleum products shipment projections that were formulated by a consultant to the Corps in 1977 are based on a number of basic assumptions, at least two that we have identified, which have not come to pass. In this instance, we wonder whether the projections are still valid despite the violation of the assumptions. Given the rapidly changing environmental and economic conditions in Boston Harbor, the justification for the project bears much closer scrutiny. Those changes should be accounted for in subsequent planning for this project.

We look forward to working with you to resolve the outstanding issues. Thank you for providing us with the opportunity to comment on this document.

Sincerely,

Richard F. Delaney
Director

RFD/BWB
cc: Charles Natale, DEQE/DWWR
Judy Perry, DEQE/DWPC
David Davis, Massport
Gordon Beckett, USFWS
Tom Bigford, NMFS
Philip Coates, DMF

BOSTON FUEL TRANSPORTATION

21 March, 1988

Division Engineer
New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Ma. 02254-9149

Dear Sir:

I would like to comment on the draft feasibility report for the dredging of certain areas in Boston Harbor sent to this office under cover letter dated 25 February, 1988.

I am the tug fleet manager at Boston Fuel Transportation, and also run the docking pilot program. Under that program, I and the five other pilots involved dock and undock all the oceangoing ships that utilize this company's tugs for assistance in berthing. This means we handle almost 90 percent of the total number of such ships calling in this port. As docking pilots, we are at the conn during most of the time that our tugs are alongside a ship.

The projects selected for final consideration will result in significant improvements in our ability to handle todays larger vessels with safety and efficiency in the port of Boston.

However, one economically important area has been overlooked in the feasibility report. It is the Island End River tributary of the Mystic River. This area is served by a six-foot deep Federal channel for small craft.

Three companies have berthing facilities on this body of water, Exxon Oil, Independent Cement Company, and Coldwater Seafood. The latter two facilities are host to upwards of 50 visits a year by ocean-going ships, while the Exxon Island End berth is utilized by large numbers of barges ranging in size up to 165,000 barrels in capacity. Products handled at these terminals include petroleum products, bulk cement, frozen fish, and miscellaneous general cargo, both containerized and break bulk.

Roughly half the ship movements, and some of the barges using the Exxon berth require tug assistance.

The deeper draft vessels must also use tidal assistance in berthing due to lack of sufficient depth on the river, and also due to the fact that there is not enough width for one ship to proceed past another except at high water, and in some cases, not even then.

When this latter occurs, the vessel desiring to pass must, instead, wait until the moored vessel has finished its business and departed the berth. The resulting delays imposed by these constraints add significantly to the costs of those using these busy wharves.

Equally important, with even larger vessels being projected to call at these facilities, it becomes of vital importance to us as tug operators, that there be sufficient room for the assist tug to work alongside the ship without danger of the tug fetching up on the bank while assisting her into the berth. As it is now, there is not enough space for our tugs to work head-on to a ship being maneuvered into the cement company dock. Larger ships are on the way.

The economic pressures resulting from the various conflicting interests of the several parties that share use of this waterway at times can create dangerous situations where vessels are passing one another at very close distances, with little or no margin for safety. It costs too much money to accept the delays required in order to operate with a higher level of safety. Of course, in many instances, the size of the two ships in question prohibits movement altogether.

To leave out of the planning an area such as this that handles a large volume of ocean shipping and has become one of the busiest terminal locations in the port, when taken together in total, seems to constitute a serious omission. The principal criteria for giving attention to a given location is the liklihood of achieving an economic benefit. The large volume of shipping using the Island End River speaks loudly for its inclusion with those other areas needing improvment. To say that there is no Federal shipping channel,as such, in the river ignores the reality that this is one of the busiest berthing ares in the port, a developement that has taken place gradually over the past few years, probably in the period after most of the economic assessments used in the draft report were formulated.

In summary, this area is heavily used by commercial shipping enterprises which employ significant numbers of people. Because of its shoal water, tidal assistance is usually required for berthing, and because of the narrowness of the channel, vessels often experience delays waiting for moored ships to depart before they can dock or undock.

I would like to urge the Corps of Engineers to give serious consideration to the need for this area to be widened and deepened in conjunction with the overall improvement scheme detailed in the feasibility report.

Sincerely yours,
Boston Fuel Transportation

David P. Galman
Manager, Tug Fleet

DEPARTMENT OF THE ARMY
COLD REGIONS RESEARCH AND ENGINEERING LABORATORY, CORPS OF ENGINEERS
HANOVER, NEW HAMPSHIRE 03755-1290

March 7, 1988

Mr. Mark Habel
Coastal Develooment Branch, Building 114 South
U. S. Army Engineering Division, New England
424 Trapelo Road
Waltham, MA 02254-9149

Dear Mr. Habel:

Reference announcement of release of draft feasibility report and environmental assessment for navigation improvements at Boston Harbor, Massachusetts.

The project is well engineered. CRREL has no comments.

Sincerely,

Guenther E. Frankenstein
Chief, Ice Engineering
Research Branch

The City of Chelsea Massachusetts

City Hall
500 Broadway
Chelsea, MA 02150
884-0407

John J. Brennan Jr., Mayor

Office of the Mayor

MEMORANDUM

TO: Army Corporation of Engineering

FROM: Harbormaster's Office

DATE: March 3, 1988

RE: DREDGING OF BOSTON HARBOR

To Whom It May Concern:

In reference to the dredging of Boston Harbor and Mystic Channel. In behalf of the City of Chelsea, I would like to make the following request for your consideration;

If it is at all possible, while the dredging is going on at the Mystic Channel you would consider dredging the area on the Southerly End of the former Chelsea Naval Hospital and the West Bank of the same area, to provide a mooring area to the residents of this area. Our City is surrounded by water, but has no public use. 90% of the area is commercial.

You may at the same time dump your excess rocks around the area as a break wall and you would not have to dump in the dumping grounds. Therefore, providing safe mooring area and less transportation costs.

I feel the dredging is good for commercial use, but at the same time provides for recreational use as well.

Thank you for your consideration.

Sincerely,

John J. Brennan Jr.

JOHN J. BRENNAN, JR.
Mayor

JJB/yv

MAR 8 1988

cc: Congressman Markey

The City of Chelsea Massachusetts

City Hall
500 Broadway
Chelsea, MA 02150
884-0407

John J. Brennan Jr., Mayor

Office of the Mayor

M E M O R A N D U M

TO: Army Corporation of Engineering

FROM: Harbormaster's Office

DATE: March 2, 1988

RE: DREDGING OF BOSTON HARBOR

To Whom It May Concern:

In reference to the dredging of Boston Harbor and Mystic Channel. In behalf of the City of Chelsea, I would like to make the following request for your consideration;

If it is at all possible, while the dredging is going on at the Mystic Channel you would consider dredging the area on the Southerly End of the former Chelsea Naval Hospital and the West Bank of the same area, to provide a mooring area to the residents of this area. Our City is surrounded by water, but has no public use. 90% of the area is commercial.

You may at the same time dump your excess rocks around the area as a break wall and you would not have to dump in the dumping grounds. Therefore, providing safe mooring area and less transportation costs.

I feel the dredging is good for commercial use, but at the same time provides for recreational use as well.

Thank you for your consideration.

Sincerely,

John L. Stec
Harbormaster

JLS/yv

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

REPLY TO ATTENTION OF

February 25, 1988

Planning Division
Coastal Development Branch

Mr. David W. Davis
Executive Director
Massachusetts Port Authority
Ten Park Plaza
Boston, Massachusetts 02116-3971

Dear Mr. Davis:

The New England Division has completed its study of the feasibility of providing improvements to the existing navigation system at Boston Harbor. A draft copy of the Feasibility Report and Environmental Assessment is attached for your review and comment. This document is being circulated for review to all known interested Federal, State, and local agencies and public interests for review prior to transmittal to the Board of Engineers for Rivers and Harbors.

In your letter of 4 August 1987 regarding this proposal, you expressed Port Authority interest to support the improvements under consideration, and as you noted members of your staff and ours have been coordinating this effort for some time.

Based on the results of our study, it has been determined that modifications to portions of the Federal navigation projects for Boston Harbor and the Mystic River are engineeringly feasible, environmentally acceptable and economically justified. The proposed modifications entail the deepening of three tributary access channels, the lower Mystic River, the Chelsea River and the South Boston Reserved Channel. The three channels, with widened maneuvering areas at their confluences with the Main Ship Channel, would be deepened from their existing authorized depth of -35 feet mean low water (MLW) to a depth of -40 feet MLW.

The estimated cost of construction of the proposed improvements is $22.7 million, of which 35 percent or $7.9 million would be required from local interests. Of this 35 percent cost-share, a minimum of 25 percent, or $5.67 million must be provided up front, while the remainder, no greater than 10 percent or $2.27 million may be financed over a period of up to 30 years. Local interests would also be responsible for deepening vessel berthing areas at the terminals of project beneficiaries to a depth of at least 40 feet and the relocation of all utilities required to enable construction. The annual benefits of this project, estimated at $5,313,000, when compared to annual costs of $2,690,000 yield net benefits of $2,623,000 and a benefit-cost ratio of 2.0.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and/or implementation funding.

In order to finalize the report in an expeditious manner, comments should reach me no later than March 28, 1988. Any comments will be included in our final report to the Board of Engineers for Rivers and Harbors.

If there are any questions, I may be contacted at (617) 647-8220. The Project Manager Mr. Mark Habel, is coordinating the investigation. should your staff desire further information he can be reached at (617) 647-8550.

Sincerely,

Thomas A. Rhen
Colonel, Corps of Engineers
Division Engineer

Enclosures

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

REPLY TO
ATTENTION OF

February 25, 1988

Planning Division
Coastal Development Branch

Mr. Thomas Bigford, Chief
Habitat Conservation Branch
National Marine Fisheries Service
2 State Fish Pier
Gloucester, Massachusetts 01930

Dear Mr. Bigford:

Enclosed for your review is the Draft Feasibility Report, and Environmental Assessment concerning the modification of the existing Navigation project located in Boston Harbor, Massachusetts.

The project involves deepening three sections of the existing Boston Harbor Federal Channels from 35 to 40 feet deep at mean low water. These are the Reserved Channel, the lower Mystic River, and the Chelsea River. Approximately 2.4 million cubic yards of material will result from dredging with disposal proposed to be at the Foul Area Disposal Site.

Although ocean disposal is proposed, bioassay/bioaccumulation testing of the dredged material will be deferred until post authorization studies. This approach and various detailed aspects of the project were discussed with Messrs. Mantzaris and Beach at a January 19, 1988 meeting in Gloucester.

We invite your review of the document and we request a determination of consultation requirements under Section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.) in regards to this activity.

Please provide written comments by March 28, 1988. Should you have any questions concerning this matter, please contact me at (617)647-8220 or Mr. Mark Habel, the Project Manager, at (617)647-8525.

Sincerely,

Thomas A. Rhen
Colonel, Corps of Engineers
Division Engineer

Enclosures

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

REPLY TO ATTENTION OF

February 25, 1988

Planning Division
Coastal Development Branch

Mr. Michael Deland, Director
Region 1
U.S. Environmental Protection Agency
JFK Federal Building
Boston, Massachusetts 02203

Dear Mr. Deland:

Enclosed for your review is a copy of the Draft Feasibility Report and Environmental Assessment for the modification of the existing Project in Boston Harbor, Massachusetts.

The project involves deepening three sections of the existing Boston Harbor Federal Channel from 35 to 40 feet deep at mean low water. These are the Reserved Channel, the Mystic River, and the Chelsea River. Approximately 2.4 million cubic yards of material will result from dredging with disposal proposed to be at the Foul Area Disposal Site.

Although ocean disposal is proposed, bioassay/bioaccumulation testing of the dredged material will be deferred until post authorization studies. This approach and various detailed aspects of the project were discussed with members of your staff at a recent meeting in Waltham.

Please provide written comments by March 28, 1988. Should you have any questions concerning this matter, please contact me at (617)647-8220 or Mr. Mark Habel, the Project Manager at (617)647-8525.

Sincerely,

Thomas A. Rhen
Colonel, Corps of Engineers
Division Engineer

Enclosures

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

REPLY TO ATTENTION OF

February 25, 1988

Planning Division
Coastal Development Branch

Mr. Gordon Beckett
U.S. Fish and Wildlife Service
Ralph Pill Building, 4th Floor
22 Bridge Street
Concord, New Hampshire 03301

Dear Mr. Beckett:

Enclosed for your review is the Draft Feasibility Report and Environmental Assessment, for the modification of the existing navigation project in Boston Harbor, Massachusetts.

The report recommends deepening three sections of the existing Boston Harbor Federal Channel from 35 to 40 feet deep at mean low water. These are the Reserved channel, the Mystic River, and the Chelsea River. Approximately 2.4 million cubic yards of material will result from dredging with disposal proposed to be at the Foul Area Disposal Site.

Although ocean disposal is proposed bioassay/bioaccumulation testing of the dredged material will be deferred until post authorization studies. This approach and various detailed aspects of the project were discussed with you and members of your staff you may recall on January 21, 1988.

Please provide written comments by March 28, 1988. Should you have any questions please contact me at (617)647-8220 or Mr. Mark Habel, the Project Manager, at (617)647-8525.

Sincerely,

Thomas A. Rhen
Colonel, Corps of Engineers
Division Engineer

Enclosure

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM MASSACHUSETTS 02254-9149

REPLY TO ATTENTION OF

February 25, 1988

Planning Division
Coastal Development Branch

Mr. James Hoyte, Secretary
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

Dear Secretary Hoyte:

Enclosed for your review is the Draft Feasibility Report, and Environmental Assessment concerning the modification of the existing navigation project located in Boston Harbor, Massachusetts.

The project involves deepening three sections of the existing Federal Channel from 35 to 40 feet deep at mean low water. These are the Reserved Channel, the Mystic River, and the Chelsea River. Approximately 2.4 million cubic yards of material will result from dredging with disposal proposed to be at the Foul Area Disposal Site.

The project itself has been coordinated with various state agencies throughout its conduct and most recently was the subject of a meeting between my staff and Mr. Davis, chief of the MEPA unit. We believe this prior coordination has proven useful in defining and shaping the components of the project. In correspondence last summer Mr. David Davis, Executive Director of Massport notified us he would be willing to act as a sponsor for the project.

Please provide written comments by March 28, 1988. Should you have any questions concerning this matter, please contact me at (617)647-8220 or Mr. Mark Habel, the Project Manager, at (617)647-8525.

Sincerely,

Thomas A. Rhen
Colonel, Corps of Engineers
Division Engineer

Enclosures

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM MASSACHUSETTS 02254-9149

REPLY TO
ATTENTION OF

February 25, 1988

ANNOUNCEMENT OF RELEASE
OF DRAFT FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENTS AT
BOSTON HARBOR, MASSACHUSETTS

The New England Division, Corps of Engineers, has completed its studies relative to the modification of the existing Federal navigation projects at Boston Harbor, and the Mystic River, Massachusetts. The study was conducted in response to two resolutions passed by the United States Senate.

The study has resulted in completion of a draft Feasibility Report including an Environmental Assessment. The study included an analysis of present and prospective levels of commerce in the Port of Boston and the existing navigation dependent facilities located along the Inner Harbor. The study and preparation of this document has been coordinated with all known affected and interested Federal, state, and local government agencies; private groups; and individuals.

Several alternative plans were analyzed to determine the plan which best meets the needs of commercial port interests. The proposed modifications consist of dredging the lower Mystic River Channel, Chelsea River Channel and South Boston Reserved Channel, from their present depth of -35 feet at mean low water (MLW) to a depth of -40 feet.

The improvements, shown on the attached plan, would entail removal of approximately 2.3 million cubic yards of silt, clay and sand and 90,000 cubic yards of fragmented ledge. The estimated cost of the proposed improvements is $22.7 million, of which the local sponsor's cost share would be 35 percent or $7.9 million. The Massachusetts Port Authority has stated its willingness to act as project sponsor.

Benefits resulting from this harbor modification would be reductions in vessel operating costs with elimination of tidal delays and reduced transportation costs for bulk commodities associated with larger cargos. Annual benefits were found to exceed annual costs by a ratio of 2.0 to 1.

If you have any questions, or wish to obtain a copy of the draft report, please contact the Project Manager, Mr. Mark Habel, of the Coastal Development Branch Branch, at:

Department of the Army
Corps of Engineers, NED
424 Trapelo Road
Waltham, Massachusetts 02254-9149
ATTN: Coastal Development Branch, Bldg. 114 South
Telephone (617) 647-8550

Comments on any aspect associated with the report findings will receive full consideration before recommendations are made in our final report to the Board of Engineers for Rivers and Harbors. It is requested that comments regarding this project be forwarded to this office by March 28, 1988.

Please bring this announcement to the attention of anyone you know to be interested in this project.

Sincerely,

Thomas A. Rhen
Colonel, Corps of Engineers
Division Engineer

Enclosure

MAILING LIST
FOR ANNOUNCEMENT OF DRAFT FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT
FOR NAVIGATION IMPROVEMENT PROJECT IN
BOSTON HARBOR, MASSACHUSETTS

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15 Christina Drive
Schenectady, New York 12303

Mr. Charles P. Buckley
Vice-President
Boston Gas Company
One Beacon Street
Boston, Mass. 02108

Mr. Jay R. Kaufman, Exec. Dir.
Mass. Bay Marine Sciences
Consortium
P.O. Box 110
Cambridge, Massachusetts 02140

Mr. Robert Magionis
117 Richmond Street
Dorchester, Massachusetts 02124

Mr. Robert Melchin
Quinoil Corporation
P.O. Box 150
Quincy, Massachusetts 02269

Mr. Dean M. Boylan, Jr. Pres.
Boston Sand & Gravel Company
P.O. Box 9187
169 Portland Street
Boston, Massachusetts 02114

Mr. Walt Landin
Boston Gas Company
201 Rivermoor Street
W. Roxbury, Massachusetts 02132

Mr. Frank Tramontozzi
50 Kirkwood Road
Boston, Mass. 02135-5156

Boston Fuel Transportation
ATTN: David P. Galman
Manager, Tug Fleet
36 New Street
East Boston, Mass. 02128

BSC Grove Boston
ATTN: Mr. Alan Randall
425 Summer Street
Boston, Massachusetts 02210

Mr. Tom O'Donnell
Coastal Cement Corp.
33 Dry Dock Avenue
Boston, Massachusetts 02210

Ms. Beth Powers
Sasaki Associates
64 Pleasant Street
Watertown, Mass. 02172

Ms. Anne Burke
Goldberg, Zoino Assoc.
GEO Building
320 Needham Street
Newton Upper Falls, MA 02164

Mr. James Bajek
Normandeau Associates
25 Nashua Road
Bedford, New Hampshire 03102

Great Lakes Dredge & Dock Co
2747 Richmond Terrace
P.O. Drawer 311
Staten Island, NY 10303-2301
ATTN: David P. McCarthy
New England Area Eng.

Independent Cement Corp.
ATTN: Scott M. Horton
Project Manager
P.O. Box 12-310
Albany, New York 12212

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149
February 25, 1988

REPLY TO ATTENTION OF

CENEDPL-C

TO WHOM IT MAY CONCERN:

Enclosed for your review and comment is a draft copy of the Feasibility Report and Environmental Assessment for the modification of the existing Federal navigation projects in Boston Harbor, Massachusetts.

Our studies have determined that deepening of the existing navigation channels in the lower Mystic River, Chelsea River and Reserved Channel are economically justified and environmentally acceptable. The three channels including maneuvering areas would be deepened from their existing 35-foot depth below mean low water (MLW) to a depth of -40 feet MLW.

The proposed modifications would entail removal of approximately 2.3 million cubic yards of silt, clay and sand and 90,000 cubic yards of fragmented ledge. The estimated cost of the proposed improvements is $22.7 million of which the local sponsor's cost share would be 35 percent or $7.9 million. The Massachusetts Port Authority has stated its willingness to act as project sponsor.

Any comments on this report should be forwarded to:

Division Engineer
New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254-9149

It is requested that all comments reach this office no later than March 28, 1988. should you require additional information, please contact the Project Manager, Mr. Mark Habel at (617) 647-8550.

Thomas A. Rhen
Colonel, Corps of Engineers
Division Engineer

Enclosure

US Army Corps of Engineers
New England Division

News Release

88-90	Sue Douglas
Release No.	Contact
Upon Receipt	617-647-8264
For Release	Phone

424 Trapelo Road, Waltham, MA. 02254-9149

February 25, 1988

ENVIRONMENT

.OOD CONTROL

MILITARY
ONSTRUCTION

NAVIGATION

RECREATION

RIV" SYSTEMS

SHORE
PROTECTION

DEEPENING BOSTON HARBOR RECOMMENDED

WALTHAM, Mass. -- Deepening portions of the Boston Harbor federal navigation project to 40 feet is economically and environmentally feasible, according to a new draft report released by the U.S. Army Corps of Engineers' New England Division.

The draft document summarizes the findings of an investigation of the feasibility of providing greater depths in the three major tributary navigation channels in the harbor. The report recommends that the channels in the Mystic and Chelsea rivers and the Reserved Channel, now 35 feet deep, be dredged to 40 feet, the same depth that exists in the Inner Harbor Main Ship Channel. The improvements would increase navigational efficiency and safety of harbor operations and reduce or eliminate tidal delays for larger vessels.

In addition to the three major channels, two other areas would be deepened to 40 feet. These include the Inner Confluence, which provides access to the Mystic and Chelsea rivers, and a widened maneuvering area at the entrance to the Reserved Channel.

The project would involve the removal of 2.3 million cubic yards of ordinary material and 90,000 cubic yards of rock. The material is considered suitable for open water disposal and would be transported to the Foul Area Disposal Site in Massachusetts Bay.

The Engineers estimate that this work would cost $22.7 million. Of this amount, nonfederal interests would be required to cost share in the amount of $7.9 million or 35%. The Massachusetts Port Authority has indicated a willingness to act as a sponsor for this project.

The study also considered, but found not to be economically feasible, straightening, widening and deepening of the principal harbor entrance, the Broad Sound North Channel. It also concluded that the size of the Presidents Roads Anchorage could be increased by over 65 acres at no cost by declaring new channel limits that would extend into naturally deep areas.

The Engineers are currently seeking comments on their recommendation. Copies of the report may be obtained from and comments should be forwarded to the New England Division, U.S. Army Corps of Engineers, 424 Trapelo Road, Waltham, MA 02254-9149. The deadline for submitting comments is March 28, 1988.

Once all comments have been received and reviewed, the Engineers will compile a final report which will be submitted to the Secretary of the Army through the Board of Engineers for Rivers and Harbors and the Chief of Engineers. Actual construction is dependent on project authorization and appropriation of funds by the Congress.

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

REPLY TO ATTENTION OF:

February 22, 1988

Planning Division
Coastal Development Branch

Honorable Edward M. Kennedy
United States Senate
Washington, DC 20510

Dear Senator Kennedy:

The New England Division has completed its study as to the need of modification to the existing Federal navigation project for Boston Harbor, Massachusetts.

A draft copy of the Feasibility Report and Environmental Assessment is attached for your review and comment. This document is being circulated for review to all known interested Federal, State and local agencies and interests for review prior to transmittal to the Board of Engineers for Rivers and Harbors.

Our studies have determined that modifications to portions of the Federal navigation projects for Boston Harbor and the Mystic River are engineeringly feasible, environmentally acceptable and economically justified. The proposed modifications entail the deepening of three tributary access channels, namely the lower Mystic River, the Chelsea River and the South Boston Reserved Channel. The three channels would be deepened from their existing authorized depth of -35 feet mean low water (MLW) to a depth of -40 feet MLW.

The Massachusetts Port Authority has expressed its willingness to act as the local sponsor of this project. The project would primarily benefit local petroleum products importers and scrap exporters, which together last year accounted for over 93 percent of shipping in the Port of Boston. Project benefits would be realized through reduced tidal delays for larger vessels and the ability to receive and ship larger cargos.

The estimated cost of construction of the proposed improvements is $22.7 million, of which $7.9 million would be required from local interests. The annual benefits derived from this project modification are estimated at $5,313,000, when compared to annual costs of $2,690,000 yield net benefits of $2,623,000 and a benefit-cost ratio of 2.0.

In order to finalize this report in an expeditious manner, comments should reach me by March 28, 1988. They will be included in our final report to the Board of Engineers for Rivers and Harbors.

If there are any questions, I may be contacted at (617) 647-8220. The Project Manager Mr. Mark Habel, is coordinating the investigation. Should your staff desire further information he can be reached at (617) 647-8550.

Sincerely,

Thomas A. Rhen
Colonel, Corps of Engineers
Division Engineer

Attachment

Copy Furnished:

Honorable Edward M. Kennedy
United States Senator
2400A JFK Federal Building
Boston, Massachusetts 02203

COPIES FURNISHED TO:

CONGRESSIONAL INTERESTS

Honorable Edward M. Kennedy
United States Senate
Washington, DC 20510

Honorable John F. Kerry
United States Senate
Washington, DC 20510

Honorable Edward J. Markey
House of Representatives
Washington, DC 20515

Honorable Edward M. Kennedy
United States Senator
2400A JFK Federal Building
Boston, Massachusetts 02203

Honorable John F. Kerry
United States Senator
2003F JFK Federal Bldg.
Boston, Massachusetts 02203

Honorable Edward J. Markey
Representative in Congress
2100A JFK Federal Bldg.
Boston, Massachusetts 02203

Honorable Brian J. Donnelly
House of Representatives
Washington, DC 20515

Honorable John Moakley
House of Representatives
Washington, DC 02515

Honorable Joseph Kennedy
House of Representatives
Washington, DC 20515

Honorable Brian J. Donnelly
Representative in Congress
47 Washington Street
Quincy, Massachusetts 02169

Honorable John Moakley
Representative in Congress
1900C JFK Federal Bldg.
Boston, Massachusetts 02203

Honorable Joseph Kennedy
Representative in Congress
2007 JFK Federal Building
Boston, Massachusetts 02203

STATE EXECUTIVE OFFICE

Honorable Michael S. Dukakis
Governor of the Commonwealth of Massachusetts
Boston, Massachusetts 02133

Honorable Evelyn Murphy
Lieutenant Governor of the Commonwealth of Massachusetts
Boston, Massachusetts 02133

STATE LEGISLATURE

Honorable Walter J. Boverini
Senator in the General Court
Boston, Massachusetts 02133

Honorable Francis D. Doris
Senator in the General Court
Boston, Massachusetts 02133

Honorable William M. Bulger
President of the Senate
Boston, Massachusetts 02133

Honorable Michael LoPresti, Jr.
Senator in the General Court
Boston, Massachusetts 02133

Honorable Joseph Walsh
Senator in the General Court
Boston, Massachusetts 02133

Honorable Richard A. Volk
Rep. in the General Court
Boston, Massachusetts 02133

Honorable Michael F. Flaherty
Rep. in the General Court
Boston, Massachusetts 02133

Honorable George Keverian
Speaker of the Mass. House
Boston, Massachusetts 02133

Honorable Richard J. Rouse
Rep. in the General Court
Boston, Massachusetts 02133

Honorable Emanuel Gus Serra
Rep. in the General Court
Boston, Massachusetts 02133

Honorable Salvatore F. DiMasi
Rep. in the General Court
Boston, Massachusetts 02133

CITY OF BOSTON

Honorable Raymond Flynn
Mayor of the City of Boston
City Hall
Boston, Massachusetts 02201

OTHER COMMUNITIES

Honorable John McCarthy
Mayor of Everett
484 Broadway
Everett, Massachusetts 02149

Honorable George V. Collela
Mayor of Revere
281 Broadway
Revere, Massachusetts 02151

Honorable John Brennan
Mayor of Chelsea
500 Broadway
Chelsea, Massachusetts 02150

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM MASSACHUSETTS 02254-9149

REPLY TO ATTENTION OF

CENEDPL-C (1105-2-20) 17 February 1988

MEMORANDUM FOR: Commander, USACE, 20 Mass. Ave., N.W.
Washington, D.C. 20510-1000

1. The New England Division has completed a draft Fessibility Report and Environmental Assessment to support the modification of the existing Federal projects for the Mystic River and Boston Harbor, Massachusetts. The report recommends deepening of the existing Federal navigation channels in the lower Mystic River, Chelsea River and Reserved Channel from their existing 35-foot depth to a depth of 40 feet. The Massachusetts Port Authority has expressed its willingness to act as project sponsor. Total cost of construction is estimated at $22.7 million with the 35 percent local cost share equal to $7.9 million. The benefit-cost ratio is 2.0.

2. In accordance with ER-1105-2-10, dated 18 December 1985 and ER-1105-2-60 dated 22 November 1985, enclosed for your review and comment are 10 copies of the draft report and Fact Sheet and copies of the draft LCA.

3. The project sponsor and congressional interests are being informed of our action (copies of letters attached).

THOMAS A. RHEN
Colonel, Corps of Engineers
Commander

Attachments

EC 1105-2-122
February 1988

FACT SHEET
BOSTON HARBOR, MASSACHUSETTS
DRAFT FEASIBILITY REPORT

1. Name of Project: Boston Harbor & Mystic River Massachusetts

States: Massachusetts

Counties: Middlesex, Suffolk, Norfolk and Plymouth

Congressional Districts:
Existing Project: 7th, 8th, 9th, 10th, and 11th
Improvements: 7th, 8th, and 9th

2. Type of Report: Draft Feasibility Report and Environmental Assessment.

3. Location of Study Area: The Port of Boston is located on the eastern cost of Massachusetts on Massachusetts Bay.

4. Authority: Senate resolutions, Committee on Public Works, 1 March 1968 and 11 September 1969.

5. Dates of Corps Action: Draft report released for public and agency review February 1988.

6. Problems Needs and Opportunities Identified: While Boston's principal entrance and main access channels are 40 feet deep, the 3 major tributaries, along which the majority of port terminals are located, are 35 feet deep. The resulting tidal delays and limits on vessel size and loading place significant restrictions on shippers. An opportunity exists to substantially reduce the cost of transporting bulk commodities through the Port of Boston by eliminating or reducing tidal delays for larger vessels.

7. Alternative Plans Considered: Deepening of each of the three tributaries, the lower Mystic River, Chelsea River and Reserved Channel were examined at incremental depths up to 40 feet.

A Nonstructural improvement entailing designation of specific Federal channel limits through the middle reaches of the harbor would result in an enlarged deepwater anchorage, at no cost.

Other nonstructural alternatives were determined to be infeasible.

8. Planning Principles Used: Planning Guidance Notebook, EM 1110-2-1613,

9. Recommended Plan: (See Attached Figure): Boston Harbor Project South Boston Reserved Channel - Narrow the 35-foot channel from 430 to 400 feet wide, widen the channel at its confluence with the Main Ship Channel, relocated Harbor lines at the confluence and deepen the channel to 40 feet. Local dredging of widened berthing areas along the southern limit to 40 feet or greater.

President Roads Ship Channel - Nonstructural designation and remarking of specific Federal channel limits along the southern reach of the Roads connecting the outer confluence of the 3 entrance channels with the Inner Harbor Main Ship Channel, resulting in a 20% enlargement of the deepwater anchorage to @ 420 acres.

Inner confluence Area - widen the 35-foot confluence of the Mystic and Chelsea Rivers and deepen to 40 feet to enable deepening of the 2 river channels.

Chelsea River Channel - Deepen the existing 35-foot channel to 40 feet. Local dredging of berthing areas at the major petroleum terminals to 40 feet or greater and local relocation of utility crossings beneath the channel.

Mystic River Project: Deepen the existing 35-foot channel to 40 feet, except for an area at the upstream limit along the southern shoreline where the waterfront has been converted to non-navigation dependant uses. Local dredging of major terminal berthing areas to 40 feet or greater.

10. Physical Data On Project Features:

a) Structural:

(1) Channel Dredging (to 40 feet)
Reserved Channel - 438,000cy & 40,000cy rock
Mystic River Channel and Inner confluence
- 1,114,000cy + 54,000cy rock
Chelsea River Channel - 770,000cy (no rock)
TOTAL - 2,322,000cy + 94,000cy rock

(2) Berthing Area Dredging by locals (to _ 40 feet)
Reserved Channel - 48,000cy
Mystic River Channel - 140,000cy
Chelsea River Channel - 131,000cy

(3) Utility Relocations - Chelsea River Channel only - lower Boston Edison and MBTA electric cables, MRWA water tunnel and Boston Gas gas siphon.

b) Nonstructural:

(1) Channel Limit Designation/Realignment - President Roads Ship Channel - Designate specific Federal channel limits through the Roads to jurisdictionally connect entrance channels with the Main Ship Channel and enlarge the anchorage area by 20 acres in deepwater.

11. New Policy Directions Recommended: None.

12. Views of States and Non-Federal Interests: Views being solicited by review of the draft report and EA.

13. Views of Federal, State and Regional Agencies: Views being solicited by review of the draft report and EA.

14. Status of Final EIS: In consideration of the greater impacts associated with the recent maintenance dredging of the channels being considered for deepening in relation to the identified impacts of the work being proposed, a draft Environmental Assessment and FONSI were prepared and included with the draft feasibility report for public and agency review.

UPDATED FINANCIAL COSTS OF RECOMMENDED PLAN

15. Estimated Implementation Costs (July 1987)

Federal	
Corps - 65% of Construction Cost	$14,744,000
U.S. Coast Guard - Relocate Nav. Aids	12,000
Interest During Construction	1,123,000
TOTAL	$15,879,000
Non-Federal	
25% of Construction Cost - Initial	$ 5,671,000
10% of Construction Cost - Ultimate	2,268,000
Berthing Area Deepening	2,551,000
Utility Relocation - Chelsea River only	2,050,000
TOTAL	$12,540,000

16. Non-Federal Implementation Costs:

Contribution toward construction cost - 35%	$ 7,939,000
Berthing Area Deepening to 40 feet or greater	
Reserved Channel	$ 430,000
Mystic River Channel	1,084,000
Chelsea River Channel	1,037,000
Utility Relocation - Chelsea River Only	
Lower Electrical Cables	$ 50,000
Lower Water Tunnel	1,000,000
Lower Gas Siphon	1,000,000
TOTAL	$ 12,540,000

17. Estimated Annual O&M Costs: (July 1987)

Federal - All Corps Costs	
Increased Annual Maintenance Dredging Costs	
Reserved Channel	$ 8,400
Mystic River and Inner Confluence	64,000
Chelsea River Channel	18,900
TOTAL	$ 91,300

18. Non-Federal Annual O&M Costs:

Increased Berthing Area Maintenance	$ 40,000

EVALUATION

19. Estimated Effects: (July 1987)

Account	Average Annual Equivalent Beneficial Effects ($1,000)	Average Annual Adverse Effects ($1,000)
	Commercial Navigation	
NED		
- Reserved Channel	$1,973,000	$ 698,000
- Mystic River & Inner Confluence	1,730,000	1,233,000
- Chelsea River	1,610,000	874,000
- President Roads	---	---
- Combined Plan	5,313,000	2,690,000

Project Economic Life - 50 years

Net Annual Benefits - $2,623,000

Benefit-Cost Ratio: 2.0 (Discount Rate FY87 8 7/8)

NED Plan Recommended - YES

20. Direct Beneficiaries:

Reserved Channel: Belcher New England, Inc. - Petroleum
Boston Edison - Petroleum for Power Generation.

Mystic River Channel: Exxon USA, Inc. - Petroleum
Distrigas of New England - LNG
Prolerized - Scrap Metal Export
Boston Edison - Petroleum for Power Generation

Chelsea River Channel: All Petroleum - Mobil Oil, Gibbs BP, Northeast Petroleum, Gulf Oil Co., and Belcher New England, Inc.

Other minor beneficiaries may exist, such as; Massport, the project sponsor, which operates container terminals on both the Reserved Channel (Conley terminal) and Mystic River (Moran Terminal); sugar and cement terminals on the Mystic River and additional petroleum terminals on the Inner Confluence and Chelsea River.

AUTHORIZED OR COMPLETED PLANS

21. Relationship to Other Plans: The proposed improvements are a modification (channel deepening) of the existing Federal projects for Boston Harbor and the Mystic River, Massachusetts. With the exception of completion of minor portions of width of the 40-foot Main Ship Channel extension; authorized in 1945 for Boston Harbor, which are inactive, both projects are completed. A portion of the inactive part of the 40-foot deepening for the Main Ship Channel is included in the area currently recommended for deepening of the Inner Confluence Area.

22. Cumulative Funds Expended to Date: (Annual Report - 1986)

	Boston Harbor	Mystic River
Construction		
Federal	$25,313,000	$3,223,000
Non-Federal	None	None
Maintenance		
Federal	$ 9,821,000	$1,972,000

SUPPLEMENTAL INFORMATION

23. Preconstruction Planning Costs:

Environmental Testing and Disposal Site Determination	$110,000
Engineering and Design	$440,000
TOTAL	$550,000

* Note: These costs are included in Item 15 construction costs.

The Propeller Club of the United States
PORT OF BOSTON INC.
P. O. BOX 577 BOSTON MASS. 02102

October 23, 1987

Mr. Mark Habel
U.S. Army Corps. of Engineers
New England Division
424 Trapelo Rd.
Waltham, MA 02172

Dear Mark:

Again our sincere thanks for speaking to the Propeller Club last night.

I am very greatful to you for making the evening most interesting and presenting such a stimulating program. The success of your talk was clearly evidenced by the barrage of questions and statements which you were so kind to field.

The Propeller Club will take action to ensure a Boston Harbor Navigation Improvement Program and we will approach the necessary people and agencies to accomplish this.

Your mention of the 3rd Harbor Tunnel restrictions and their impact on improvements to the Chelsea Creek area bother me and I would be greatful if you would provide me with detail of the "tunnel restrictions" which you mentioned.

We hope that this dialogue can be continued as your project continues and we will keep in touch with you.

In the meantime I would invite you to consider joining the Propeller Club and enclose a membership application with some basic details which include the information that we were founded in 1927 (sixtieth birthday November 7th).

Best personal regards,

Kars

A.R. Pope
President

ARP/ps

Enclosure

MASSPORT TEN PARK PLAZA BOSTON MA 02116-3971 (617) 973-5500 TELEX 94-0365

August 4, 1987

Col. Thomas Rhen
Division Engineer
USACE, New England Division
424 Trapelo Rd.
Waltham, MA 02254-9149

Dear Colonel Rhen:

The purpose of this letter is to express the Massachusetts Port Authority's intent to support the improvements being considered at Boston Harbor.

For some months now members of our staffs have been coordinating their efforts in the important planning studies to deepen certain areas of Boston Harbor. Based on studies that have been made to date, The Authority will support and be willing to act as the sponsor of the recommended improvements. (We understand that our expression of support, indicating our intent to be the project sponsor, is at this point, non-binding.)

We realize that the non-Federal sponsor must arrange for providing 35 percent of the total project cost in addition to including necessary lands, easements, rights-of-way, relocations and the disposal area. We are aware that before implementing the project, there will be a requirement to enter into a Local Cooperation Agreement and we understand that a draft agreement will be prepared before the final report is completed.

We look forward to working with the Corps of Engineers to complete the report and eventual implementation of these important improvements.

Sincerely yours,

David W. Davis
Executive Director

DWD:CBS:cc

3193E

United States Department of the Interior

FISH AND WILDLIFE SERVICE
400 RALPH PILL MARKETPLACE
22 BRIDGE STREET
CONCORD, NEW HAMPSHIRE 03301-4901

AUG 20 1987

Joseph Ignazio, Chief
Planning Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Ignazio:

This Planning Aid Letter has been prepared to assist you in the preparation of the draft feasibility report regarding the proposed deep-draft navigation improvement project in Boston Harbor.

The proposed project is designed to deepen a portion of the 35-foot section of the Inner Harbor-Main Ship Channel to 40 feet, which would provide a 40 foot channel wider than the existing 600 feet. The Reserved Channel would be deepened to 40 feet with the development of a small 40 foot deep turning area at the confluence of the Reserved and Main Ship Channels. Moreover, the existing 35-foot Mystic and Chelsea River channels would be dredged to a 40 foot depth. Approximately 2 million cubic yards of rock, silt and silty sand material from this project would be disposed at the Foul Area Disposal Site. If approved and constructed, the project would improve the navigation of deep draft ships in Boston Harbor.

Both the Inner and Outer Harbors support a diversity of finfish and shellfish resources. The greatest concentration and diversity of finfish occurs in the Outer Harbor, although many species can be found in the Inner Harbor as well. Although the water quality in portions of Boston Harbor does not meet national goal uses due to industrial and domestic pollution, finfish provide a recreational sport fishery for many people. Menhaden, winter flounder, ocean pout, cod, bluefish, pollack and striped bass can be expected to occur in Boston Harbor. The Boston Harbor area also supports numerous anadromous fish runs. Shad, alewife, smelt and blueback herring enter, or attempt to ascend, most of the streams and rivers flowing into Boston Harbor. Turbidity and sedimentation may impact anadromous fishes if the work is conducted in the Inner Harbor during the spring. Fish are moving into the mouths of streams and rivers during the spring-summer months prior to their annual spawning run. Rivers supporting anadromous fish runs should not be dredged from June to September 30.

There are numerous intertidal flats in both the Inner and Outer Harbors that support soft shell clams, and other important invertebrates. Most of the flats are located in Hingham and Dorchester Bays, although it is of interest to note that there are some flats along the northern side of Logan Airport. Your feasibility report should identify these flats and address ways to avoid impacting these resources. An issue that needs to be addressed is how

increased turbidity and sedimentation from the dredging operation may affect soft shell clams and other mollusks. This is particularly important if the sediment is suspended for long periods of the time and carried by currents to the flats. We are concerned that sustained additional sedimentation above the normal levels in the harbor could adversely impact mollusks by hindering their respiratory and feeding mechanism. The distance between these flats and the dredging sites does reduce the likelihood of impacts to the shellfish but we believe that this potential impact should be addressed.

Severe turbidity might also impact commercial lobster pounds along the Boston waterfront since their intake pipes remove water from the Inner Harbor. When the Harbor is turbid, such as during severe storms, sediments have caused significant losses in lobster tanks. This possible impact should also be addressed.

According to your estimates, approximately 2 million cubic yards of rock, silt and silty sand material will be disposed of at the Foul Area. It seems premature to identify the Foul Area as the disposal site for all dredge material without having conducted the necessary bioassay/bioaccumulation studies. We reviewed contaminant levels in eleven Boston Harbor projects involving dredging in the past 10 years (Table 1). Nearly all of the contaminants measured in the Boston Harbor Federal navigation channel exceed the New England River Basin Commission's Category II criteria. Other projects in the Harbor involving dredging contain many contaminants which also exceed the Category II criteria. This Class III material is too contaminated to be considered for open water disposal since there is no reasonable way in which this material can be capped in 300 feet of water.

Biological testing was conducted in three of the projects and all demonstrated significant bioaccumulation of contaminants using "Green Book" criteria. Since testing procedures frequently underestimate bioaccumulation, sediments yielding statistically significant amounts of bioaccumulation are particularly onerous.

Another example of the grossly contaminated sediments found in the proposed project area is found in the research of Shiaris and Jambard-Sweet as reported in Marine Pollution Bulletin 17(10): 469-472. The report indicates very high total PAH levels in the Boston Inner Harbor, with mean total sediment PAHs ranging from 10 parts per million at the mouth of the Reserved Channel to 718 parts per million in the Fort Point Channel. The highly toxic and carcinogenic nature of PAH as a group of compounds, coupled with their relative persistence, makes open water disposal of these materials unwise.

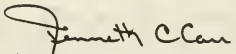
One last point regarding the nature of sediments in the project area relates to the scope of testing. As you know, bulk sediment analyses address only nine metals, PCB's, oil and grease, "petroleum hydrocarbons," and occasionally

DDT. There are many other hazardous contaminants in the Harbor that are not included in contaminant analyses summaries because they are not tested. For instance, the focus of the Shiaris and Jambard-Sweet Study was PAHs, which were found in significant levels in the project area. The EPA lists 129 priority pollutants that are considered potential threats to living organisms. Many of these are likely found in the project area, although their presence is unconfirmed due to the lack of specific analyses. If disposal options other than containment are anticipated for project sediments, we recommend expanding bulk sediment analyses to include at least the 129 priority pollutants, and possibly some of the so-called non-conventional pollutants.

Furthermore, since Corps policy is to use the material in the most beneficial manner, the ledge/rock material should not be disposed of at the Foul Area. Rather, it should be used to create an artificial fishing reef for lobsters and finfish. Your feasibility study needs to explore the use of dredged material as a means of creating habitat. This would also provide recreation for sport fishermen. Indeed, any material not contaminated should be considered for use in a beneficial manner.

We trust these comments are helpful and we look forward to continued coordination with your staff.

Sincerely yours,



Gordon E. Beckett
Supervisor
New England Area

TABLE 1. HIGHEST REPORTED LEVELS OF CONTAMINANTS AT VARIOUS SITES IN BOSTON HARBOR

Project	Hg	Pb	Zn	As	Cd	Cr	Cu	Ni	V	PCB	PHC	%O&G
Boston Edison, Res. Chnl	11**	63	105	55**	1.7	77	68	35	57	720		4.4
City of Boston Boston Hbr. Dredge	.28	627**			11**	163*	309*			10,000**		1.82
Jeffries Pt. Yacht Club Boston Harbor	<1	37	83	15*	.9	40	27	26	38			
Blue Circle Atlantic Mystic River, Mass.	1.5*	290**	440**	31**	4.5*	200*	240*	38		2,800**		4.3
Fan Pier Boston Harbor	<.08	294**	378*	58**	5.6*	270*	294*	42		13,400**		3500ppb
North Jetty Boston Harbor	3.2**	354**	333*	33**	5*	248*	237*	39	70	480		.9
Northeast Petrol. Chelsea River	1.1*	230**	410**	21**	3.7*	480**	180	26	135**	720		6.37
Boston Edison Mystic River	2.1**	55	49	14*	2.0	35	63	170**	ND	ND		
Dredging Island End River	1.06*	390**	449**	42**	11**	110*	239*	75*				
COE 1972 Fed. Nav. Channel	1.76**	421**	533**	41**	7.6**	490**	787**	56*	329**			20.1
COE 1975 Fed. Nav. Channel	2.29**	361**	667**	24**	10**	1120**	336*	193**	257**			17.81

* Exceeds NERBC Category I

** Exceeds NERBC Category II

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

January 13, 1987

REPLY TO ATTENTION OF:
Planning Division
Coastal Development Branch

Mr. Mario H. Tocci, Director
Third Harbor Tunnel Project
Executive Office of
Transportation and Construction
Department of Public Works
99 High Street
Boston, MA 02110

Dear Mr. Tocci:

I am responding to your letter of November 20, 1986 concerning the Federal navigation channel in Boston Harbor.

The existing navigation channel authorized by Congress as shown on the attached drawing is 1200 feet wide and is divided into two 600-foot wide lanes. The outbound, South Boston side lane, is maintained to a depth of -40 feet below mean low water (MLW) while the inbound East Boston side lane is maintained to a depth of -35 feet MLW. Maintenance dredging to these depths plus a 2 foot overdepth allowance is accomplished periodically, as needed.

The ongoing Navigation Improvement Study is being conducted in response to Congressional resolutions one of which specifically calls for investigating the feasibility of providing a 40-foot depth (plus a two foot over depth allowance) across the entire 1200-foot width of the channel. Your proposed tunnel profile, which allows for 2 feet of channel over depth dredging and a further 5 feet of cover above the tunnel is considered minimal to avoid damage or interference from dredging operations. These clearances should be maintained below 40 feet MLW across the entire 1200-foot width of the channel and extend a minimum distance of 35 feet on each side of the channel to allow for side slope dredging.

Our studies indicate that deepening this Main Ship Channel beyond -40 feet MLW (plus a two foot overdepth allowance) is not economically justified at this time due to the present "glut" in supply in the petroleum market. Should market conditions change in the future, deepening beyond -40 feet MLW may prove to be justified. It must be noted that the region's major petroleum products terminals are located upstream of the tunnel crossing in the Mystic and Chelsea Rivers. Massport's Moran Terminal, Mystic Piers and the recently acquired East Boston Piers are also located upstream of the proposed tunnel crossing.

The New England Division is not in a position to predict future petroleum market conditions and their relation to posaible channel deepening at this time. It should be noted that the deepening of the Port of New York to -55 feet MLW was authorized by the Water Resources Development Act of 1986. Final tunnel height will impose a permanent restriction on channel depth which will limit harbor use. Responsible officials of the Commonwealth of Massachusetts must decide whether or not to limit future navigation in Boston Harbor to 40 feet.

Should you have any questions, please contact me at (617) 647-8220 or the Project Manager Mr. Mark Habel, of my staff, at (617) 647-8550.

Sincerely,

Thomas A. Rhen
Colonel, Corps of Engineers
Division Engineer

JOHN KERRY
MASSACHUSETTS

United States Senate

WASHINGTON, DC 20510

November 21, 1986

Thomas A. Rhen
Colonel, Corps of Engineers
Division Engineer
424 Trapelo Road
Waltham, MA 02254

Dear Colonel Rhen:

Thank you very much for your recent correspondence regarding the Corps of Engineers' deep-draft navigation improvement project in Boston Harbor. I appreciate the updated information.

Although I was unable to attend the meeting on November 12, I am interested in being kept apprise of any developments with the project.

Again, thank you for the information.

Sincerely,

John F. Kerry
United States Senator

JK/mc

The Commonwealth of Massachusetts
Executive Office of Transportation and Construction
Department of Public Works
99 High St., Boston, MA 02110

November 20, 1986

Mr. Ralph M. Atkinson
U. S. Army Engineers Division
New England, Regulatory Branch
424 Trapelo Road
Waltham, Massachusetts 02254-9149

Subject: Corps of Engineers
Shipping Channel Depth Requirements
Boston Harbor

Dear Mr.Atkinson:

On November 12, 1986, our representatives attended a presentation by your Mr. Mark Habel concerning the current status of the Corps of Engineers' Deep Navigation Study for Boston Harbor.

Our management consultant for the Third Harbor Tunnel (I-90)/Central Artery (I-93) Project, Bechtel/Parsons Brinckerhoff, is currently in the preliminary design phase of the immersed tunnel crossing of the Boston Harbor. The major determining factor for the establishment of a vertical profile for the tunnel is the size and location of the navigation channel as it crosses the alignment.

Based on the above presentation, we understand the following:

1. The Corps of Engineers has determined that all future dredging of the navigation channel in the Inner Harbor will not exceed a project depth of 40 feet.

2. The Corps may, in the future, widen the channel.

For us to proceed with the design of the Third Harbor Tunnel and properly meet the future requirements of your agency, we request that you confirm the above maximum channel depth and also provide us with a plan showing the geometry of the widest navigation channel planned for the Third Harbor Tunnel area.

NOV 26 1986

The present alignment of the proposed tunnel links the slip south of Pier 5 with Bird Island Flats, but the final alignment may vary somewhat north and south of this location. The size and location of the planned navigational channel are critical influences on the preliminary design of the tunnel. We, therefore, would appreciate your earliest response to our request.

In establishing the tunnel profile, we will provide a two foot allowance for overdredging and five feet of protective cover for that portion of the tunnel located below the shipping channel. We would appreciate your thoughts on this matter, as well.

Should you have any questions, please contact Robert Snowber, Agency Liaison Manager at 350-0049.

Thank you for your assistance in this matter.

Sincerely,

Mario H. Tocci, Director
I-90/1-93 Project

LS:ms

The Commonwealth of Massachusetts
Office of the Secretary of State
Michael Joseph Connolly, Secretary

Massachusetts Historical Commission
Valerie A. Talmage
Executive Director
State Historic Preservation Officer

November 19, 1986

Mr. Joseph L. Ignazio
Chief, Planning Division
Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02554-9149

RE: Deep-Draft Navigation Improvement Project, Boston Harbor

Dear Mr. Ignazio:

Thank you for providing the MHC with information concerning the proposed project referenced above. Staff of the MHC have reviewed the materials you submitted.

Review of MHC files indicates that the Chelsea Street Bridge is located within the project area. The Chelsea Street bridge is considered to be eligible for listing on the National Register of Historic Places, as it is the only Strauss heel-trunnion bascule bridge known to survive in the Commonwealth. The MHC requests that alternatives to replacing the bridge, such as bridge repair, be carefully considered.

These comments are provided in compliance with Section 106 of the National Historic Preservation Act of 1966 (36 CFR 800).

If you have any questions, please contact Jordan Kerber of my staff.

Sincerely,

Valerie Talmage

Valerie A. Talmage
Executive Director
State Historic Preservation Officer
Massachusetts Historical Commission

xc: Marie Bourassa, ACE

VAT/JK/dr

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM MASSACHUSETTS 02254

14 October 1986

REPLY TO
ATTENTION OF

Planning Division
Coastal Development Branch

Honorable John F. Kerry
United States Senate
Washington, D.C. 20510

Dear Senator Kerry:

The purpose of this letter is to re-establish formal coordination with your office regarding the proposed deep-draft navigation improvement project in Boston Harbor. As you know, we have had an on-going study of this project for the last 15 years. Recent reformulation of the project at the request of our Washington office has resulted in a "scaled down" version of the original plan of improvement as seen in the attached map (Figure 1).

The proposed dredging will be designed to deepen all or a portion of the 35-foot section of the Inner Harbor-Main Ship Channel to 40 feet so as to provide a 40-foot channel wider than the existing 600 feet. Also being considered are deepening of the Reserved Channel to 40 feet with the establishment of a small 40-foot deep turning area at the confluence of the Reserved and Main Ship Channels (see figure 1). Additionally, the existing 35-foot Mystic and Chelsea River channels are proposed to be dredged to a depth of 40 feet, and the 35-foot confluence of these two upper harbor tributary channels will also be dredged to a depth of 40 feet. At the request of the Boston Harbor Pilots Association we will also investigate the feasibility of removing a portion of Finn's Ledge to 40 feet so as to eliminate the bend in the Broad Sound North Entrance Channel. Approximately two million cubic yards of rock, silt and silty sand material from this project will be disposed at the Foul Area Disposal Site (see figure 2). The dredging project is designed to expand the navigational efficiency and safety of Boston Harbor for present deep draft traffic.

We are planning a coordination meeting with the attached list of Federal, State and local agencies on November 12, 1986, here in Waltham, to present an update on this project and solicit comments and concerns.

If any questions arise regarding this project, please contact the undersigned at (617) 647-8220. Mr. Mark Habel (Project Manager) may be reached at (617) 647-8525, or Mr. David Tomey (Ecologist) at (617) 647-8139.

Sincerely,

Thomas A. Rhen
Colonel, Corps of Engineers
Division Engineer

Enclosure

Copy Furnished:

Honorable John F. Kerry
United States Senator
2003F JFK Federal Building
Boston, Massachusetts 02203

Same letter sent to:

Honorable John F. Kerry
Unites States Senate
Washington, D.C. 20510

Honorable John R. McCarthy
Mayor of Everett
484 Broadway
Everett, MA 02149

Honorable George V. Collela
Mayor of Revere
281 Broadway
Revere, MA 02151

Mr. Robert C. Noonan
Chairman, Board of Selectmen
Town Hall; Metcalf
Winthrop, MA 02151

Honorable Thomas J. Nolan
Mayor of Chelsea
500 Broadway
Chelsea, MA 02150

Mr. Stephen Coyle, Director
Boston Redevelopment Authority
One City Hall Square
Boston, MA 02108

Honorable Raymond Flynn
Mayor of the City of Boston
City Hall
Boston, MA 02201

Honorable Edward J. Markey
House of Representatives
Washington, D.C. 20515

Honorable John J. Moakley
House of Representatives
Washington, D.C. 20515

Honorable Thomas P. O'Neill, Jr.
Speaker of the House of
Representatives
Washington, D.C. 20515

Honorable Brian J. Donnelly
House of Representatives
Washington, D.C. 20515

Mr. James S. Hoyte, Secretary
Executive Office of Environmental
Affairs
100 Cambridge Street
Boston, MA 02202

Honorable Edward M. Kennedy
United States Senate
Washington, D.C. 20510

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

14 October 1986

REPLY TO
ATTENTION OF

Planning Division
Coastal Development Branch

Mr. Michael Deland
Regional Administrator
U. S. Environmental Protection Agency-Region I
JFK Federal Building
Boston, Massachusetts 02203

Dear Mr. Deland:

The purpose of this letter is to re-establish formal coordination with your office regarding the proposed deep-draft navigation improvement project in Boston Harbor. As you know, we have had an on-going study of this project for the last 15 years. Recent reformulation of the project at the request of our Washington office has resulted in a "scaled down" version of the original plan of improvement as seen in the attached map (Figure 1).

The proposed dredging will be designed to deepen all or a portion of the 35-foot section of the Inner Harbor-Main Ship Channel to 40 feet so as to provide a 40-foot channel wider than the existing 600 feet. Also being considered are deepening of the Reserved Channel to 40 feet with the establishment of a small 40-foot deep turning area at the confluence of the Reserved and Main Ship Channels (see figure 1). Additionally, the existing 35-foot Mystic and Chelsea River channels are proposed to be dredged to a depth of 40 feet, and the 35-foot confluence of these two upper harbor tributary channels will also be dredged to a depth of 40 feet. At the request of the Boston Harbor Pilots Association we will also investigate the feasibility of removing a portion of Finn's Ledge to 40 feet so as to eliminate the bend in the Broad Sound North Entrance Channel. Approximately two million cubic yards of rock, silt and silty sand material from this project will be disposed at the Foul Area Disposal Site (see figure 2). The dredging project is designed to expand the navigational efficiency and safety of Boston Harbor for present deep draft traffic.

We are planning a coordination meeting with the attached list of Federal, State and local agencies on November 12, 1986, here in Waltham, to present an update on this project and solicit comments and concerns. We would appreciate any resource data from the project areas (Figures 1 & 2), that your office may have, be made available at the coordination meeting to assist us in our preparation of an environmental asaessment. We also request that your agency designate a formal point of contact for future coordination.

If any questions arise regarding this project, please contact Mr. Mark Habel (Project Manager) at (617) 647-8525, or Mr. David Tomey (Ecologist) at (617) 647-8139.

Sincerely,

Thomas A. Rhen
Colonel, Corps of Engineers
Division Engineer

Enclosure

Copies Furnished:

Ms. Elizabeth A. Higgins
U.S. Environmental Protection Agency-Region I
Office of Government Relations &
Environmental Review (RGR-2203)
JFK Federal Building
Boston, Massachusetts 02203

Mr. Larry Brill, Mail Code WR/WQ/PS
Chief, Planning and Standards Section
U.S. Environmental Protection Agency-Region I
JFK Federal Building
Boston, Massachusetts 02203

Same letter sent to:

Mr. Michael Deland
Regional Administrator
U.S. Environ. Prot. Agency-Region I
JFK Federal Building
Boston, MA 02203

Mr. Howard N. Larsen, Regional Director
U.S. Dept. of the Interior
Fish and Wildlife Service
Northeast Region
One Gateway Center
Newton Corner, MA 02158

Mr. Robert T. Tierney, Commissioner
Department of Public Works
10 Park Plaza
Boston, MA 02116

Mr. Kaselis - Environ. Specialist
Commander (DPL) First Coast Guard Dist.
150 Causeway Street
Boston, MA 02114-1396

Captain G. F. Ireland
Chief, Marine Safety Division
First Coast Guard District
150 Causeway Street
Boston, MA 02114-1396

Mr. Bill Patterson
U.S. Department of the Interior
1500 Custom House
165 State Street
Boston, MA 02109

Ms. Anne D. Aylward
Maritime Director
Mass. Port Authority
10 Park Plaza
Boston, MA 02210

Mr. Tom Bigford
Chief, Habitat Conservation Branch,
NMFS
Two State Fish Pier
Gloucester,MA 01930

Mr. Joel B. Bard, Assistant Dir.
Metropolitan Area Planning Council
110 Tremont Street
Boston, MA 02108

Mr. David Clark
Environmental Compliance
North Atlantic Region
National Park Service
15 State Street
Boston, MA 02109

THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE DEPARTMENT
STATE HOUSE • BOSTON 02133

MICHAEL S. DUKAKIS
GOVERNOR

October 10, 1986

Colonel Thomas A. Rhen
Division Engineer
Corps of Engineers
424 Trapelo Road
Waltham, MA 02254

Dear Colonel Rhen:

Thank you for your recent letter to me concerning an Update Report on cooperative projects currently underway with the New England Division, U.S. Army Corps of Engineers.

Your involvement in Massachusetts is extensive, far-reaching and contributes greatly toward resolving a variety of problems.

Upon reviewing the Report, I noted the diversity of recipients at both the state and local levels that benefit from the Corps work. Also, I am aware of the coordination agreements between the Federal Government and recipient that must precede project development.

To assist in the coordination and communication elements of our mutual relationship and expedite state involvement in Corps initiatives, I am designating Richard F. Delaney, Director of the Coastal Zone Management Office as the contact point for matters involving planning, permitting and policy.

Further, I am designating John J. Hannon, P.E. Chief Engineer in the Division of Waterways, Department of Environmental Management as the contact point for construction, contractual and operational matters.

Thank you for your continuing contribution to Massachusetts.

Sincerely,

Michael S. Dukakis
Governor

MSD/JJH/RFD:dc

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

REPLY TO
ATTENTION OF

Coastal Development Branch
Planning Division

September 2, 1986

Mr. James S. Hoyte, Secretary
Executive Office of Environ. Affairs
100 Cambridge Street
Boston, Massachusetts 02202

Dear Secretary Hoyte:

I am taking this opportunity to provide you with an update of our study efforts to date of potential navigation improvements to Boston Harbor. The New England Division has been investigating various alternative improvements in response to Congressional resolutions to determine if modifications to the existing Federal Project are warranted. A draft report detailing our findings and including environmental and economic assessments is scheduled for release for local review in late 1987.

The New England Division recognizes Boston Harbor as being the region's principal commercial port. The continued vitality of Boston Harbor as a maritime waterway is crucial to the regions continued economic growth.

Our studies indicate that deepening of the three major tributary channels, namely; the Reserved Channel, the Chelsea River, and the Mystic River, to a depth of 40 feet is economically justified. The deepening of a turning area at the mouth of the Reserved Channel and a second at the Inner Confluence area at the Chelsea and Mystic Rivers will be considered as part of these analyses. Several terminal operators on each tributary have already deepened their berths beyond the existing Federal project depth of 35 feet.

Deepening of all, or a portion of the inbound Main Ship Channel lane to 40 feet between President Roads and East Boston from the existing 35 foot depth, as earlier proposed is not economically justified based upon existing traffic.

Some indications of the magnitude and costs of the improvements described in paragraph 3 are contained in the attached summary, including benefit/cost analyses together with a map showing the proposed alternatives.

My staff has been in contact with Mr. John J. Hannon, of your Division of Waterways. He indicated that his Division would be the most likely point of contact for further coordination of study efforts. A letter designating Mr. Hannon as a state point of contact would be helpful.

Should you have any questions concerning the proposed improvements, I would be happy to brief you. I can be contacted at (617) 647-8220. The project manager, Mr. Mark Habel, may be contacted at (617) 647-8525.

Sincerely,

Thomas A. Rhen
Colonel, Corps of Engineers
Division Engineer

Attachment

EDWARD J MARKEY
7TH DISTRICT, MASSACHUSETTS

COMMITTEES

INTERIOR AND INSULAR AFFAIRS

ENERGY AND COMMERCE

CHAIRMAN
SUBCOMMITTEE ON ENERGY CONSERVATION AND POWER
COMMISSION ON SECURITY AND COOPERATION IN EUROPE

Congress of the United States
House of Representatives
Washington, DC 20515

2133 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, DC 20515
(202) 225-2836

DISTRICT OFFICE
2100A JOHN F. KENNEDY BLVD
BOSTON, MA 02203
(617) 223-2781

July 9, 1986

Colonel Thomas A. Rhen
Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Colonel Rhen:

Thank you for writing to me to provide me with an update of the Corps of Engineers study on potential efforts to improve navigation in Boston Harbor. The information is useful and informative. I apologize for the delay in my response. Sam Parkman of my Washington staff and Scott Leabman of my Boston staff are folllowing closely the plans of the Corps, and I have instructed them to provide you and your office with any assistance you may need.

The Army Corps of Engineers has completed many good projects in Massachusetts and the efforts in Boston Harbor continue in that direction. Please contact me in the future if I can provide any further assistance.

Again, thank you for writing. I appreciate your taking the time to let me know your views.

With best wishes,

Sincerely,

Ed Markey

Edward J. Markey
Member of Congress

EJM/slp

SPORT, TEN PARK PLAZA, BOSTON, MA 02116-3971, (617) 973-5500 TELEX 94-0365

massport

May 29, 1986

Col. Thomas Rhen
U.S. Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham, MA 02254-9149

Dear Col. Rhen:

I am writing this letter to express Massport's interest in an 18-month schedule for completion of the Boston Harbor Deep Draft Navigation Feasibility Study that the New England Division, U.S. Army Corps of Engineers is undertaking.

One of Massport's prime legislative mandates is to stimulate the economic vitality of the New England region, including Boston Harbor's port activities. Harbor channel improvements would benefit the region.

While at this stage of your study, Massport has not really been identified as a project beneficiary, our tenants are prime users of the harbor. We own significant waterfront property and we recognize clearly the importance of developing and improving the harbor's capabilities. As an independent state authority, created by an act of the Massachusetts Legislature, we want you to know that Massport supports your feasibility investigations, and that we are anxious to continue receiving updates from you as your study moves forward.

We will keep you abreast of our maritime plans in case you see possible ways in which we might become a project beneficiary.

Sincerely,

David W. Davis
Executive Director

lv/2455M

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

REPLY TO ATTENTION OF

April 7, 1986

Coastal Development Branch
Planning Division

Anne D. Aylward
Maritime Director
Massachusetts Port Authority
99 High Street
Boston, Massachusetts 02210

Dear Ms. Aylward:

I am taking this opportunity to provide you with an update of our study efforts to date of potential navigation improvements to Boston Harbor. The New England Division has been investigating various alternative improvements in response to Congressional resolutions to determine if modifications to the existing Federal Project are warranted. A draft report detailing our findings and including environmental and economic assessments is scheduled for release for local review in June 1987.

Our studies indicate that deepening of the three major tributary channels, namely; the Reserved Channel, the Chelsea River, and the Mystic River, to a depth of 40 feet is economically justified. The deepening of a turning area at the mouth of the Reserved Channel and a second at the Inner Confluence area at the Chelsea and Mystic Rivers will be considered as part of these analyses. Several facilities on each tributary have already deepened their berths beyond the existing Federal project depth of 35 feet.

Deepening of all or a portion of the inbound Main Ship Channel lane to 40 feet between President Roads and East Boston from the existing 35 foot depth, as previously proposed in 1979 is not economically justified based on existing traffic. Should increased deeper draft traffic be projected, as a result of the three deepened tributaries and other users deepening their berthing areas, then 2-way 40-foot depth traffic in the Inner Harbor Main Ship Channel may prove to be economically viable.

Some preliminary indications of the magnitude and costs of these various improvements are contained in the attached study update summary. The summary includes preliminary benefit/cost analyses for deepening of the three tributary channels to a -40-foot depth and a map showing the proposed alternatives.

I would like to make you aware of the recent changes in construction cost sharing of policies for deep-draft navigation projects. The new policies would require non-Federal contributions of 35 percent of construction costs (25 percent at the time of construction and an additional 10 percent payable over a 30-year period).

I plan to work closely with Secretary Hoyte, Office of Environmental Affairs, specifically the Office of Coastal Zone Management and Division of Waterways in determining their attitude and/or support. I will also maintain close coordination with Mass Port Authority, specifically their Maritime Division.

Should you have any questions concerning the proposed improvements, I would be happy to brief you or I can be contacted at (617) 647-8220. The project manager, Mr. Mark Habel, may be contacted at (617) 647-8525. I will continue to keep you informed of the status of the feasibility study.

Sincerely,

Thomas A. Rhen
Colonel, Corps of Engineers
Division Engineer

Attachment

Honorable Raymond Flynn
Mayor of the City of Boston
City Hall
Boston, MA 02201

Honorable Edward M. Kennedy
United States Senate
Washington, DC 20510

Honorable Edward M. Kennedy
United States Senator
2400A JFK Federal Bldg.
Boston, MA 02203

Honorable John F. Kerry
United States Senate
Washington, DC 20510

Honorable John F. Kerry
United States Senator
2003F JFK Federal Bldg.
Boston, MA 02203

Honorable Thomas P. O'Neill, Jr.
Speaker of the House of
Representatives
Washington, DC 20515

Honorable Thomas P. O'Neill, Jr.
Speaker of the House of
Representatives
2200A JFK Federal Bldg.
Boston, MA 02203

Honorable John J. Moakley
House of Representatives
Washington, DC 20515

Honorable John J. Moakley
Representative in Congress
1900C JFK Federal Bldg.
Boston, MA 02203

Honorable Brian J. Donnelly
House of Representatives
Washington, DC 20515

Honorable Brian J. Donnelly
Representative in Congress
23077 JFK Federal Bldg.
Boston, MA 02203

Honorable Edward J. Markey
House of Representatives
Washington, DC 20515

Honorable Edward J. Markey
Representative in Congress
2100A JFK Federal Bldg.
Boston, MA 02203

David W. Davis
Executive Director
Mass. Port Authority
10 Park Plaza
Boston, MA 02710

Anne D. Aylward
Maritime Director
Mass. Port Authority
10 Park Plaza
Boston, MA 02210

COASTAL ZONE
MANAGEMENT

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

September 9, 1981

Joseph Ignazio
Chief, Planning Division
NED Corps of Engineers
424 Trapelo Road
Waltham, MA 02154

Re: Boston Harbor Improvement Dredging

Dear Mr. Ignazio:

I am writing in response to the May 12, 1981 meeting between the Corps and state resource agencies regarding Boston Harbor Improvement Dredging. At that meeting several options were presented for disposal of the four million cubic yards of sediment expected to be generated from that project.

We agree with the Corps' observation that maintenance dredging of Boston Harbor will remove the upper, most contaminated layer of sediment, leaving the relatively "clean" material for disposal during the improvement dredging. Thus, several environmentally acceptable disposal options discussed at the meeting appear to warrant further investigation.

For example, using the material to cap sanitary landfills in the Boston Harbor area ordered closed by DEQE would be one disposal option for the dredged blue clay. To determine if this is feasible, the Corps might initiate a survey of needs for this type of material by towns within a reasonable transport distance from the project. This information would also be useful in addressing the dredge disposal problems of other projects involving clay sediments. It would be shortsighted for the Corps to eliminate this option before a thorough examination was conducted.

Similarly, disposal of at least part of the dredged materials on and around the Boston Harbor Islands has potential worth exploring further. Marsh creation and island stabilization should both be considered in the Princes Head area of Peddock's Island and the southern part of Thompson's. In addition, utilizing the dredged rock material for protective rip rap and the blue clay to cap the landfill on Spectacl Island warrents further investigation. To evaluate these options, the quantity of material which might be placed on the three islands must be determined. A meeting between the Corps, MDC, DEM, and the

Thompson Island Educational Center might facilitate this type of investigation. Use of the rock ledge material for creation of an artificial fishing reef, and/or disposal of the material in quarries and gravel pits, each briefly mentioned in the meeting, should not be dismissed.

Thus, it is our feeling that several constructive options for disposal of sediments from the Boston Harbor Improvement Dredging exist and should be pursued. To address these options, a cost/benefit analysis including benefits accrued by increased land use should be computed for all of the suggested options. Although use of the Marblehead Disposal Site for sediments from this project might be feasible, it should not be considered the only alternative. If we can be of assistance with this investigation, please do not hesitate to call.

Sincerely,

Richard F. Delaney
Director, CZM

RFD:dn

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
P.O. Box 1518
Concord, New Hampshire 03301

AUG 25 1981

Colonel William E. Hodgson
Deputy Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254

Dear Colonel Hodgson:

This responds to Mr. Ignazio's letter of August 5, 1981, concerning the May 21, 1981, meeting on your study of navigation improvements for Boston Harbor. Our letter of July 29, 1981, expressed our reactions to this meeting and provided some amplification of our position on spoil disposal.

I feel that the summary of the meeting that was enclosed with Mr. Ignazio's letter is essentially correct as stated. The statement at the bottom of page 1 "that 100 acres of land would be needed for the spoil" does not correlate the 100 acres with depth and apparently none of the attendees thought to ask. Perhaps it would be worth while to construct a simple graph showing height vs. acres for the estimated amount of spill so that the relationship between these can be visualized. This would help to answer such questions as - how large a container would be needed if it is constructed in an area 20-feet deep at mean low water with a top elevation 10 feet above high water and a 6-foot tidal range?

The Lynn landfill site was discussed on page 3 where it is mentioned that the rock spoil might be used for a proposed breakwater. Lynn Harbor supports important populations of softshell clam, blue mussel and other invertebrates that have attracted a wintering population of waterfowl, including black duck and scaup; and the harbor provides habitat for juvenile and adult finfish of many species. Our report of September 25, 1978, described the resources, expressed our concern for the habitat losses that will occur if the breakwater is constructed and noted that mitigation studies are needed. Creation of a fishing reef should receive more attention during the later stages of the study.

We hope that you will continue your efforts to avoid ocean dumping.

Sincerely yours,

Gordon E. Beckett

Gordon E. Beckett
Supervisor

PHILIP G. COATES
DIRECTOR

The Commonwealth of Massachusetts
Division of Marine Fisheries
Lowell Sallonstall State Office Building
100 Cambridge Street
Boston, Massachusetts 02202

727-3193

August 25, 1981

Mr. Joseph L. Ignazio
Chief, Planning Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254

Dear Mr. Ignazio:

This letter is in response to your letter of August 4, 1981 where you requested the Division review of the minutes of the meeting held on May 21, 1981 concerning the navigation channel Improvement study in Boston Harbor. Please be advised that the Division basically concurs with the minutes enclosed in your letter. At the present time, without benefit of bioassay and other information, we would favor disposal at either a contained upland site or the Marblehead disposal area. It is also noted relative to comments by Mr. Mantzaris of the National Marine Fisheries Service that considerable planning would be necessary relative to site location of any propose artificial fishing reef construction with rock material from the harbor area.

If you have any questions relative to these comments, please contact me.

Very truly yours,

W. Leigh Bridges
Assistant Director

:ni

Boston Redevelopment Authority

Robert J. Ryan, Director

August 19, 1981

Mr. Joseph L. Ignazio
Chief Planning Division
Corps of Engineers
424 Trapelo Road
Waltham, MA 02254

Dear Mr. Ignazio:

I have received your letter of August 6, 1981, as well as the previous one dated May 12. Despite a review of our current and potential development projects we found no suitable location within the City of Boston for the fill to be produced by your proposed dredging project. If any such site should develop in the near future I will be back in touch with you.

In the mean time, I would appreciate it if you would contact me if you are considering any private fill sites within the City. Although the City is quite concerned with filling of water areas we are generally supportive of your project and would see no potential problem with the use of the spoils from the channel deepening project on land areas.

However, we do continue to be concerned with the disposal of the top layer of toxic spoil that must be removed before the deepening dredging could commence. I hope this serves as an adequate reply to your request and that you are able to proceed with the channel improvement projects on your schedule.

Sincerely,

Robert J. Ryan
Director

1 City Hall Square
Boston, Massachusetts 02201
(617) 722-4300

The Commonwealth of Massachusetts

SPECIAL COMMISSION ON
DEVELOPMENT OF BOSTON HARBOR

Room 15 • State House • Boston 02133

SEN. JOSEPH B. WALSH
Chairman

REP. MICHAEL F. FLAHERTY
Co-chairman

THOMAS ENNEN
Director

(617) 727-9668
727-9669

August 18, 1981

Mr. Joseph L. Ignazio, Chief
Planning Division
New England Division
Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts

Dear Mr. Ignazio:

I am writing to comment on your letter regarding the on-going study for navigation channel improvements in Boston Harbor.

This project has three separate obstacles to overcome, some of which are within your domain, others with one responsibility elsewhere. I will let you choose:

1. Dredge Spoils Disposal

The 21 May 1981 meeting revealed an anomaly in the Corps management of dredging in the Harbor. I understand that this project assumes a maintenance dredge, removing the somewhat toxic surface sediments, will occur prior to an improvement dredge. The maintenance dredge spoil disposal will be fraught with problems to the degree the spoil is ajudged to be contaminated. The improvement dredge spoil disposal is a problem of volume. However, I would recommend that the Corps, in spite of the fact that these two projects are housed in separate divisions or departments,, undertake combined planning looking toward a thorough and comprehensive program. We at the state and local level must play a key role in resolving disposal problems for both these projects. Integrated planning and project management will lend substantial facility to the work we must do.

Further, the state and local levels are attempting to grapple with spoils disposal as the result of our interest in carrying out state, local and privately funded dredging. I would like to request the Corps assistance in this regard in the form of a cooperative effort to secure one or several solutions which serve all or most of these Federal and State projects.

2. Funding

As you probably are aware, Congress is considering several very different approaches to new cost distribution formulas for various maritime services such as dredging, Coast Guard, Etc. Project proponents should be made aware of the current formula and Congressional and Corps procedures and timeframes for both the maintenance and improvement projects so that we can compare the existing setup to the various alternatives now under consideration. Provision of this information by the New England Corps Division would advance the general understanding of these matters and would produce well informed and reasoned support.

3. Several other maintenance and/or improvement projects have been nominated or must, in the course of the Corps' historic legal responsibility, be undertaken; the Neponset and Weir Rivers, Winthrop Channel and the Dorchester Bay Channel come immediately to mind, but the actual list is much longer. The Special Commission on the Development of Boston Harbor is going to begin this fall to outline a comprehensive dredging program for the Harbor. This program will include both anticipated Federal Projects and State, local and privately sponsored efforts.

In order to provide this Commission with a complete picture of all projects and to fix responsibility for specific areas of the Harbor, I would like to request a report from the Corps detailing both the current channel responsibilities of the Corps and a complete list of projects, maintenance and improvement, now underway or anticipated.

Let me complete this letter by stating that this Commission is most appreciative of the cooperative and helpful attitude expressed by the Corps. I very much hope we can expand, in the coming months, our combined efforts realizing a complete program for maintenance of water depth.

Sincerely,

Thomas Ennen
Director

cc: Martin Pilsch, Massport
Reno Marconi, Massport
John Hannon, Waterways Division
Sterling Wall, DEQE
Harriet Diamond, CZM

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
P.O. Box 1518
Concord, New Hampshire 03301

Colonel William E. Hodgson
Deputy Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254

JUL 2 9 1981

Dear Colonel Hodgson:

This letter is provided to aid you in the Boston Harbor Navigation Study. Your staff presented the current status of the project and other technical data at the workshop meeting with state and Federal interests on May 21, 1981. This letter comments on and amplifies our position on spoil disposal, the main topic of the meeting.

We are pleased that you are seeking alternate inshore and upland sites for the spoil. Use of such a site will help to prevent additional contamination of the ocean.

The presence of shellfish habitat in the vicinity of the Squantum Point, Logan Airport and Boston Harbor Islands means that these sites would have low priority. They need not be eliminated, however, if replacement of the habitat is included as part of the plan.

We continue to believe that upland disposal to cover existing landfills, as suggested by Mr. Wall, would be the most environmentally acceptable procedure. Placing the material in a container constructed in the harbor also should receive more study. It should be planned for spoil from both improvement and maintenance dredging. Appropriate management of the site could provide wildlife benefits, including wetland habitat for waterfowl, and the site could act as a stockpile for material to be used for landfill cover.

We understand that the listed sites in the harbor are all potential containment sites. The only one that appears worth more detailed study is Spectacle Island. Spoil material could be used to cover the existing dump, convert it into wildlife habitat and eliminate the reported leaching of contaminants. We recommend additional consideration of this site.

Containment sites at other locations should be located. Shallow water sites would be less desirable than deeper water sites because the shallow and intertidal areas have important biological functions. Sites located in areas where the water is deeper than 20 feet at mean low water should have the least adverse impacts and might be the most desirable.

Dredged rock can be used to create reefs for fish and shellfish habitat. These could be either totally submerged sites or sites where the rock would emerge above the high tide line. Either proposal would be a sound use for the mateial. Use of the rock to form a dike for a containment site also should be considered. We will work with you, the State Division of Marine Fisheries, National Marine Fisheries Service, and other state agencies to locate suitable sites for construction of a reef and to search for possible containment sites. Construction of a submerged reef for fish and lobster habitat should be added to your liat of alternate disposal sites.

The remaining alternatives, Fort Point Channel, Boston Marine Industrial Park, reclamation of quarries and gravel pits, and filling of vacant land all appear to have little potential for adverse impacts to fish and wildlife resources, and we recommend that they be given high priority in your studies.

Please keep us advised of your progress.

Sincerely youra,

Gordon E. Beckett

Gordon E. Beckett
Supervisor

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Quality Engineering
Division of Wetlands Protection
OFFICE OF THE DIRECTOR
One Winter Street, Boston, MA. 02108

June 19, 1981

Colonel C.E. Edgar, III
Division Engineer
Department of the Army
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, MA. 02154

RE: Boston/Dredging
Boston Harbor Navigation
Improvement Study
NEDPL-C

Dear Colonel Edgar:

A technical staff member from this division attended the May 21, 1981 meeting concerning the Boston Harbor Navigation Improvement Study and the associated options for disposal of the dredge materials. We sent a representative to this meeting in response to your May 12, 1981 letter. The following comments on the twelve options discussed at the meeting are based upon consideration of the following factors:

(1) quality of the dredge material,
(2) suitability of use and,
(3) whether the option will still be feasible when the dredging actually takes place.

Disposal of the dredge materials at the Marblehead Disposal Area (option A, also known as the Boston Foul Area) appears to be the most realistic and practical for sediments of this quality in the time frame we are discussing.

Creation of an artificial fishing reef (option H) should also be further evaluated for the disposal of the 600,000 cubic yards of blasted rock material. This option should be appropriate for this uncontaminated material at any time and would most probably enhance fish habitat. Careful consideration should be given, however, to locating such a reef to avoid creating a hazard to bottom fishing operations.

Further possibilities for disposal of clean materials may involve utilizing the Boston Harbor Islands (option E). Clean silt and clay material could possibly be used to create upland

wildlife refuges and intertidal substrate for salt marsh creation. The salt marsh would have to be located in sheltered areas of the islands to survive and some of the rock material could be used as perimeter shore protection. This option might be particularly appropriate on Spectacle Island (42°19'28"N, 70°59'10"W), an old landfill island in Boston Harbor. While available information suggests there are some shellfish resources in the intertidal area, these could be transplanted if such a project was undertaken.

Other options were presented but appear to be much less feasible. Disposal of the materials in Lynn, Ma. as part of their proposed waterfront project (option C) which would involve sealing of the sanitary landfill, landscaping a waterfront park and constructing a breakwater must be more fully evaluated. The clean silt and clay and the rock could probably be utilized if the project were still feasible 8-10 years from now. The status of the Lynn Waterfront Project is presently unknown.

Resurfacing of landfills (option I), reclaiming of quarries and gravel pits (option J) and filling on vacant parcels of land (option L) may be undertaken as disposal options for clean silts and clays and the rock. There are, however, serious logistical, legal, time, and cost sharing problems associated with any land disposal options such as these.

Finally, disposal of the dredge materials by filling Fort Point Channel (option B), Squantum Point in Quincy (option D), Boston Marine Industrial Park (option F) or at Logan Airport (option G) are inappropriate for a variety of engineering, structural, time, navigational and environmental reasons.

We suggested an additional option at the May 21 meeting which we hope will be considered. This suggestion was to separate the project into components; first, perform the critical maintenance dredging before 1987 utilizing ocean disposal and second, proceed after this with the improvement portion of the project.

The Division of Wetlands Protection is pleased to have been able to participate in this evaluation. Should you need further assistance, please feel free to contact Mr. Sterling Wall of my technical staff at 935-2160 extension 141.

Sincerely,

Roderick Gaskell

Roderick Gaskell, Director
Division of Wetlands Protection

RG:SW:cam

CC: Wm. T. St.Hilaire, Regional Environmental Engineer
DEQE N.E. Regional Office
S. Wall, Coastal Geologist
DEQE N.E. Regional Office

The City of REVERE, MASSACHUSETTS

GEORGE V. COLELLA, Mayor

OFFICE OF THE BOARD OF HEALTH

57 WINTHROP AVENUE, REVERE, MASS. 02151 • TEL 284-3600

Dr. Albert W. Kelley, Chairman | Alexander J. DeNisco, Member | James V. Fiore, Member | Allan S. Graff, Member

RECEIVED
CITY OF REVERE
JUN 5 2 11 PM '81
OFFICE OF THE MAYOR

June
Fifth
1981

George V. Colella, Mayor
City Hall
Revere, Massachusetts 02151

Re: Boston Harbor Navigation Improvement Study

Dear Sir:

We do not have any areas within city limits that, in my opinion, could be used as a disposal site for the dredged materials from the above referred project.

I am in agreement with the statement of the Corps of Engineers that the open ocean is the most viable method for disposal. Especially in light of the fact that the sedements to be removed have been, or are in fact being contaminated by raw sewage.

Ocean disposal would provide a much easier dilution of this contamination. Land based disposal may cause secondary pollution.

Very truly yours,

Felix F. DeSisto
Health Agent
Revere Board of Health

FFD/ra

Town of Weymouth
Town Hall 75 Middle Street E. Weymouth, MA 02189 (617) 335-2000

Conservation
Commission

June 5, 1981

Re: Boston Harbor Navigation
Improvement Study.

Colonel C.E. Edgar III,
Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, MA 02254

Dear Colonel Edgar:

Thankyou for allowing the Town of Weymouth to comment on the above referenced project proposal. Representing the Town of Weymouth, I have a few comments to make. Although no portion of this project will directly impact upon waters under the jurisdiction of the Town of Weymouth, we are concerned with the proposed Squantum Point dredge disposal area.

Our concerns are with the potential impact that this disposal site may have on the Weymouth Back and Fore Rivers. The estuary systems involved with these rivers are the feeding and reproductive grounds for many variety of both fin fish and shell fish. Without going into detail, the Town of Weymouth would like to preserve these areas for their environmental and economic characteristics. I would like to see included in your draft study, the potential impact of this disposal site on the Weymouth Back and Fore Rivers, and their resources, from possible siltation of adjacent waters, and also from the presence of heavy metals and other contaminants within the dredge material. The Town of Weymouth, although not necessarily opposed to the use of this site, feels that this area should be studied in your report. Upon completion of this draft study, the Town of Weymouth would appreciate the opportunity to review its contents.

Due to the requested site size and volume requirements for potential on-shore disposal sites, it is my opinion that there are no suitable areas within this Town. However, without regard to the economics of such an operation, I believe that on-shore disposal can serve a worthwhile function.

If the Corps of Engineers plans to hold public information sessions on this project, the Town of Weymouth would appreciate notice of such events. Also, please include us in any mailings regarding this project.

Sincerely,
For the Town of Weymouth,

James R. Lafond

James R. Lafond
Conservation Administrator

CC: Board of Selectmen, Town of Weymouth

Metropolitan Area Planning Council 44 School St. Boston, MA 02108 Tele. 617/523-2454

June 3, 1981

C E Edgar III
Colonel, Corps of Engineers
Division Engineer
424 Trapelo Road
Waltham, MA 02254

Dear Colonel Edgar:

This letter is in response to your undated letter regarding the Boston Harbor Navigation Improvement Study currently being conducted by your office. Your letter requested feasible sites for land disposal of 4 million cubic yards of harbor bottom material and 600,000 cubic yards of rock ledge.

As I discussed with Dirk Zwart of your staff in a phone conversation, even a preliminary assessment of the seven sites listed in your letter raises doubts about most, if not all, of these sites. The impact of any filling in Boston Harbor poses serious environmental questions, and since the nature of the dredge material makes it unsuitable for beach restoration, there would seem co be little likelihood of a harbor use. In a conversation with Marjorie O'Malley of CZM the one possible option to consider is Paddocks Island.

A question that should be given very thorough study before any detailed consideration is made of using the dredge material as cover for landfills is the potential for leachate. Since proper closure and landfill leachate continues to be a significant environmental problem, particularly in regard to water supply and ground water, then the bioaccumulation tests should provide as much information as possible on the presence of heavy metals and leachate potential.

Depending on the results of the bioaccumulation tests, it would appear that ocean dumping presents a more feasible alternative than the sites listed, and certainly, no alternative land disposal sites can be suggested.

We appreciate the opportunity to review the land-disposal alternatives, and if we can be of assistance in this study or related matters, please contact us.

Very truly yours,

Allison Harper

Allison Harper, Director
Land & Environmental Quality

AH:lpb
cc: Ms. Marjorie O'Malley, CZM

CITY OF BOSTON
OFFICE OF THE MAYOR
CITY HALL, BOSTON

KEVIN H. WHITE
MAYOR

June 3, 1981

C. E. Edgar, III
Colonel, Corps of Engineers
Division Engineer
424 Trapelo Road
Waltham, MA 02154

RE: Availability of Disposal Sites

Dear Colonel Edgar:

As requested in your letter of May 12, 1981, I am pleased to cooperate with the Army Corps of Engineers' investigation of viable disposal sites for the harbor bottom material that will be dredged up during the course of the Boston Harbor modification program.

In appreciation of the volume of responses anticipated, I will proceed directly to a brief discussion of the potential site locations of closest proximity and interest to the city of Boston.

Boston Marine Industrial Park is the sole location specified over which the City of Boston has direct authority. A study of future needs stretching into 1987 and beyond has been made. It appears very unlikely the additional land fill will be required.

At Fort Point Channel, possibility exists that the Metropolitan District Commission (MDC) may have a requirement for a small amount of fill for the combined sewer overflow project. The City of Boston would not be opposed to this.

The question of further land fill at Logan Airport is of concern. In view of the Corps' specific recommendation of areas on the north and northeast sides for fill and your contact of Massport General Director David W. Davis, I believe that it would be in the best interest of all concerned to make clear at this time the City of Boston's continuing opposition to further filling at Logan Airport now or in the future.

The potential needs of the Boston Harbor Islands would best be discussed with the Harbor Islands State Park.

I appreciate the opportunity to present the City of Boston's position with regard to disposal sites. Should you have any questions or require additional information, please feel free to contact me.

Sincerely,

Kevin H. White
Mayor

The Commonwealth of Massachusetts
Metropolitan District Commission
20 Somerset Street, Boston 02108

SEWERAGE DIVISION

June 1, 1981

Colonel C.E. Edgar III
Division Engineer
Dept. of the Army
N.E. Division, Corps of Engineers
424 Trapelo Rd.
Waltham, MA 02254

Attn: NEDPL-C

Dear Colonel Edgar:

We have reviewed your letter of May 12, 1981 regarding certain dredging operations in connection with the Boston Harbor Navigation Improvement Study. In addition, your letter has been reviewed by the MDC Parks and Water Divisions. No apparent conflict with MDC plans or facilities exists from the proposed dredging.

The proposed locations of spoil disposal do concern us, however. Filling of the Fort Point Channel is specifically opposed by this agency. Not only is such filling aesthetically unacceptable, but interference with a proposed combined sewer overflow treatment plant and a waterfront park would occur. In addition, it should be noted that specific laws now exist which preclude filling of harbor areas in Quincy such as Squantum Point.

As a final note, I would very much like to have a copy of any sediment analyses done by or for the Corps in preparation for this project. We foresee several dredging projects in the harbor area in the near future and would like to be able to compare results. In addition, the data will help us to better understand the impacts of our existing wastewater treatment facilities on the benthic environment in the harbor.

Sincerely yours,

Francis J. Hopcroft

FRANCIS H. HOPCROFT
Director Project Planning & Management

FJH:Inn

Town of Hull

BOARD OF SELECTMEN

MUNICIPAL BUILDING
HULL, MASSACHUSETTS 02045

May 29, 1981

C.E. Edgar, III
Colonel, Corps of Engineers
Department of the Army
424 Trapelo Road
Waltham, MA 02254

Dear Colonel Edgar:

The Board of Selectmen has reviewed your correspondence dated May 12, 1981 regarding the Boston Harbor Navigation Improvement Study, and advises you that, there is no suitable land site in Hull that could be used for disposal of the referred to dredge material.

The Board appreciates your concern for its input regarding this project and offers whatever assistance it is capable of providing.

Sincerely,

Christopher J. McCabe

Christopher J. McCabe
Executive Secretary

CJM/cf

May 27, 1981

Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02254

Attn: Col. C.E. Edgar, III, Code NEDPL-C

Ref: Boston Harbor Navigation Improvement Study

Dear Col. Edgar:

The Hingham Harbor Development Committee has been asked by the Board of Selectmen to review your letter of 12 May on the subject of alternatives for disposal of dredged material from the proposed Boston Harbor improvements.

We note that the Town of Hingham will not be impacted by any of the presently proposed dredged material disposal options, hence it is inappropriate for us to comment on their viability. We are unable to offer any additional suggestions for alternative sites since we also have had a problem disposing of dredged material from our very shallow harbor. We had to resort to ocean dumping for our last dredging operation because of stringent environmental requirements for on-land disposal and the poor mechanical properties of the dredged material when used for shoreline improvements.

If any of the land-based or shallow-water disposal options are selected we would like to be informed of the results of the project because of their probable applicability to harbor improvement in Hingham. We would also appreciate a copy of the results of the bioassay and bioaccumulation tests that are presently being evaluated.

Sincerely yours,
Hingham Harbor Development Committee

Charles I. Malme

Charles I. Malme, Chairman

cc: Board of Selectmen

Arthur H. Tobin
Mayor

Department of Public Works
JAMES J. RICCIUTI
Commissioner

City of Quincy, Massachusetts

May 26, 1981

Colonel C. E. Edgar, III, Division Engineer
Corps of Engineers, New England Division
424 Trapelo Road
Waltham, MA. 02254

Dear Colonel Edgar:

In behalf of Mayor Arthur H. Tobin, this letter is written in response to your communication dated May 12, 1981 regarding the Boston Harbor Navigation Improvement Study which is being conducted by your office.

The information submitted by you has been studied, and the only area we could recommend would be the Boston Harbor Marina. However, since the Marina property is privately owned, any further information should be obtained from Mr. Walter Hannon at 328-0600.

Very truly yours,

James J. Ricciuti
Commissioner of Public Works

JJR:hd
C.C.: Mayor Arthur H. Tobin

APPENDIX 4

SECTION D

BOSTON PILOTS
88 LONG WHARF – BOSTON, MASS. 02110
TEL. (617) 227-3875

August 1, 1979

Colonel Max B. Scheider, Div. Engineer
U.S.Army, Engineer Division, N. E.
424 Trapelo Road
Waltham, Mass. 02154

Dear Col. Scheider:

The Boston Pilots are keenly interested in the status of the Boston Harbor Navigational Improvement Project, which has been many years in its developmental stages. The impetus of major containerberth construction, L.N.G. traffic and generally larger ships are among the factors lending a sense of urgency to the implementation of this program.

We would like to know when this project will be made public. We would also like to receive a copy of the project in its present form. We look forward to the opportunity to comment upon the essential aspects of the plan.

Throughout the long process, we have been impressed by the professionalism of your staff and consultants, which has helped to sustain us over the years.

Sincerely,
William T. Mitchell
William T. Mitchell
Representative, Boston Pilots

C.C.
Sen. Edward Kennedy
Sen. Paul Tsongas
Rep. Joseph Moakley
Gov. Edward King

MARITIME ASSOCIATION
OF
GREATER BOSTON
470 ATLANTIC AVENUE, BOSTON, MASS. 02210
TELEPHONE: 542-2020

March 8, 1979.

Department of the Army
Corps of Engineers New England Division
424 Trapelo Road, Waltham, Mass. 02154.

Genttlemen: Att. Mr. Donald Martin; Chief, Coastal Engineering.

The Board of Governors of the Maritime Association has directed that we ascertain the progress being made by your organization in the improvement of the Main Ship Channel of Boston Harbor. As you know this project has been under consideration for some years and is badly needed for safety and efficient navigation.

A report of progress from you will be appreciated.

Yours sincerely,

JOHN J. HALLORAN
Manager.

Distrigas of Massachusetts Corporation

18 Rover Street
Everett, Massachusetts 02149
Tel. (617) 423-5959

March 2, 1979

U. S. Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham, Massachusetts 02154

ATTN: Mr. Rudy Cocchiarella
Coastal Development Branch

Dear Mr. Cocchiarella:

In our telephone conversation of February 22, 1979 you had requested an evaluation of the effect that the Proposed Boston Harbor/Mystic River Dredging Project, if implemented, would have upon LNG shipping to the Distrigas Terminal in Everett especially in light of the U. S. Coast Guard imposed restrictions upon LNG vessel drafts and harbor transits.

Basically Distrigas has signed with Sonatrach, the Algerian National Petroleum Company, a twenty (20) year supply contract which equates out to the delivery of seventeen (17) full cargoes per year of a ship with a capacity of approximately one hundred and twenty-five thousand cubic meters (125,000 M^3). This contract went into effect January 1, 1978 although the Algerians have not yet achieved their full contractual delivery rates. The vessel nominated to make these deliveries over the long term was the Algerian 125,000 M^3 LNG carrier "Mostefa Ben Boulaid" which has to date made two (2) deliveries. A number of deliveries have been made by vessels of smaller size and cargo carrying capacity.

Currently due to the limited channel depth, the U. S. Coast Guard limits the draft of the Mostefa Ben Boulaid which would be 34.5 feet with a normal full load to 33 feet and less if it can be foreseen that unusually low tide conditions will prevail at the vessel's arrival at Boston Harbor. To achieve this, the vessel can only load to a maximum of 89.6% of normal full volume capacity which would result in approximately three million six hundred thousand dollars ($3,600,000) per year of non-productive freight charges, all of which could be recouped through the dredging project.

This reduced cargo loading spread out over one year also equates out to approximately twelve million dollars ($12,000,000) worth of energy per million British Thermal Units (MMBTU), which not only fails to reach the United States but also must be made up from substitite, more expensive sources; i.e. propane, synthetic natural gas (SNG), imported oil, etc., the only alternative being to do without.

Finally, there are several additional U. S. Coast Guard imposed restrictions which can impact heavily upon ship operating costs and demurrage. The ship is only permitted to transit into Boston Harbor during periods of daylight and in good visibility (two miles or greater). When the vessel is at the Distrigas berth, it must be maintained at all times in a state in which it can be underway and successfully negotiate the channel, clearing the bottom by at least one (1) foot in an emergency, upon thirty (30) minutes notice. This means that the ship's arrival draft must be reconciled with such factors as time of low water, channel depth at low water, vessel pumping rates, plus time required for harbor transit, mooring, hook-up, cooldown and unloading. The purpose of this is to define a period or "window" of time in which the LNG ship must be underway for the berth from its Broad Sound anchorage so as to be able to transit the harbor, moor, hook-up, cooldown piping and pump off sufficient LNG cargo to be able to clear the bottom at the most shallow part of the channel by at least one (1) foot at the time of low water, still complying with all other regulations. As a practical matter, with the Mostefa Ben Boulaid, this "window" works out to approximately eight (8) to eleven (11) hours before the time of low water and must occur in daylight with at least two (2) to three (3) hours of daylight remaining at the initiation of harbor transit. The proposed dredging project would eliminate harbor depth as a constraint thereby opening up this "window" period virtually to all daylight hours less the two (2) to three (3) hours at the end of the day which a vessel would require to get to the berth before dark.

While it is impossible to project in advance the times of ship arrival it is estimated conservatively that of the current one million dollars per year ($1,000,000/year) budgeted for demurrage/ ship operating costs, one half of a million dollars per year ($500,000/year) would be saved as a result of implementation of the proposed harbor dredging project.

It is hoped that the foregoing adequately addresses the issues you have raised. We would be prepared to add additional substantiation, discuss this further with you or even submit testimony if desired. Please feel free to contact either myself or even more appropriately, Mr. Robert G. Norton, Vice President of Marketing and Supply for Distrigas Corporation, at 423-5959 (or 423-6000) Extension 229. My extension is 250.

Very truly yours,

George B. Auchy
Terminal Manager
45-4

GBA/pbm
cc RGNorton

PAUL GUZZI
Secretary of the Commonwealth

The Commonwealth of Massachusetts
Office of the Secretary
Massachusetts Historical Commission
294 Washington Street Boston, Massachusetts 02108
(617) 727-8470

July 5, 1978

Joseph L. Ignazio
Chief, Planning Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02154

Re: Main Ship Channel Dredging: Boston Harbor

Dear Mr. Ignazio:

Thank you for your letter of 28 June 1978. The Massachusetts Historical Commission feels that the dredging and disposal of materials from North Channel, President Roads Channel, and Broad South Channel will not effect any historic properties listed or eligible for the National Register.

If the MHC can be of further assistance, please contact Valerie Talmage, Staff Archaeologist.

Sincerely,

for Patricia L. Weslowski
State Historic Preservation Officer
Acting Executive Director
Massachusetts Historical Commission

PLW/SCH/lh

xc: John Wilson

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
P. O. BOX 1518
CONCORD, NEW HAMPSHIRE 03301

June 26, 1978

Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Sir:

This Planning Aid report has been prepared to assist you in the preparation of the feasibility report on dredging the Federal main-ship channel in Boston Harbor.

From our current information, the proposed project would involve dredging about 5-1/2 million cubic yards from the existing channel by bucket dredge. About 5 million cubic yards of this material consists of soft bottom sediments and 1/2 million cubic yards consists of ledge rock. Portions of the channel would be deepened and widened. The foul area near Middle Bank is being considered as the potential spoil site. Estimates indicate that 2 to 2-1/2 years will be needed to complete the project.

Fish and Wildlife Resources

In general, both the Inner and Outer Harbors support a diversity of fish and shellfish resources. Finfish are found in both harbors, although the greater concentrations and diversity occur in the Outer Harbor. Shellfish flats are numerous and are the economic base for many shellfish companies. The diversity of finfish species provide good recreational as well as commercial fishing oportunities. Water quality in Boston's Inner Harbor is impaired by industrial and domestic pollution and does not meet national goal uses.

The 1975 Massachusetts Sport Fish Survey showed that 13 major sport fish species were taken in the Boston area. In the area from Houghs Neck to Quincy Bay an excellent winter flounder fishery exists, supporting the largest recreational flounder fishery in the state. Menhaden can be found throughout Boston Harbor. Around Castle Island, bluefish, pollack, cod, flounder, and, occasionally, bass can be caught. Recent ichthyoplankton surveys of the Salem area north of Boston showed the presence of eggs and larvae of at least 24 fish species, which are likely to be found within Boston Harbor as well. Middle Bank, southeast of the foul area, is also an extremely productive and heavily fished area. In this area fishermen catch whiting, tuna, and cod in the summer.

The Boston area also contains numerous anadromous fish runs. Shad, alewife, smelt, and blueback herring enter, or at least attempt to enter, most of the streams and rivers which drain into Boston Harbor.

There are numerous softshell clam flats in both the Inner and Outer Harbors. In 1976, 17,800 bushels, valued at $20/bushel wholesale, were harvested in Boston Harbor. This represented 93% of all clams processed at the Newburyport depuration plant. Flats are located mostly in Hingham and Dorchester Bays, although it is also of interest to note that there are some flats along the northern side of Logan Airport. In general, roughly 30-50% of all commercially harvested softshell clams in Massachusetts are found in Boston Harbor. All the clams must go through the depuration plant at Newburyport before being processed. Lobsters are harvested mostly in the Outer Harbor, especially in Quincy and Hingham Bays.

Impacts and Concerns

Information on resources within the Federal channel is very limited. However, the sides of the channel bottom probably contain populations of benthic organisms, such as polychaetes. Frequent turbulence from passing ships probably prevents development of any significant populations of organisms within the vessel tracks. With this in mind, we are not as concerned with the actual dredging site as we are with turbidity and sedimentation resulting from dredging operations. We are concerned with the tentative plans to dump the spoil at the foul site without extensive efforts to develop beneficial alternative uses for the material.

As mentioned earlier, Boston Harbor contains numerous highly productive softshell clam flats. The turbidity and sedimentation (the degrees of which would be determined by the sediment partical size and water circulation patterns) might affect these organisms if the suspension is long lasting and the currents are strong enough to carry the sediments to the flats.

The Boston Harbor aquatic environment is by nature very silty, and shellfish can withstand increased turbidity and sedimentation for short periods of time, such as during storms. However, sustained additional sedimentation, could adversely affect the clams by hindering their respiratory and feeding mechanisms. We realize that the distance between these flats and the dredging site makes a direct impact remote, but we do feel that it is a potential impact which should be addressed during the planning process. Plans should be made for monitoring the areas affected by sedimentation and turbidity, and if the water circulation and tidal patterns are such that a flat is threatened, the plans should call for dredging operations to be temporarily ceased or moved to a different area.

Turbidity and sedimentation might also impact the anadromous fish populations if work is done in the Inner Harbor during the spring when the fish are traveling towards the mouths of the streams and rivers in order to migrate upstream and spawn. Plans to avoid dredging in the Inner Harbor during the critical 3-month period between March and June should be incorporated into the feasibility report.

Severe turbidity might also impact the commercial lobster pounds all along the Boston waterfront because their intake pipes take water directly from the Inner Harbor. When the harbor is turbid, such as during severe storms, the sediments have caused significant losses in the lobster tanks. This possible impact should also be addressed.

Blasting the ledge rock has the potential of harming fish in the immediate area, and plans should be developed to also monitor this work. In regard to this 1/2 million cubic yards of rock, we are interested in seeing an alternative use developed for this material instead of discarding it in the foul area. One idea might be to use it to create an "artificial fishing reef," which would not only create habitat for fish and lobster but would also provide recreation for local sport fishermen.

We recommend that beneficial alternative uses be developed for the remaining 5 million cubic yards of spoil. Estimates indicate that only 1/2 million cubic yards of material will be maintenance dredged; the remaining 4-1/2 will be "new" material and should not be polluted. The Detroit and Buffalo Corps Districts have essentially stopped dumping their polluted spoil in the Great Lakes and have begun using it for such things as reclaiming gravel pits and limestone quarries, resurfacing solid waste landfills, and creating barrier islands. In light of the Fishery Management Council's concern about indescriminate dumping in the ocean, we believe that an extensive exploration of alternative uses should be made before definite plans are made to use the foul area near Middle Bank.

Also depending on the water circulation patterns, if the foul area is ultimately used, dumping might cause enough turbidity to adversely affect the productive Middle Bank fishery area to the southeast. Monitoring should be planned here also, and if adverse impacts occur, a change in dumping procedure should be planned, such as longer intervals between dumpings to allow the water currents to lessen the concentration of sediments in the water.

In summary, we offer the following conclusions and recommendations:

1. That alternative uses for the spoil material and ledge rock be developed, or at least fully explored and described, in the project report. If the rock material can be used for an artificial reef or similar structure, we would be happy to assist you in choosing a location.

2. That plans be made in the project document to either cease or limit dredging operations in the Inner Harbor for the period from March 15 - June 15 during anadromous fish migrations.

3. That plans be made in the project document to monitor blasting, dredging and dumping operations to insure that the shockwaves, sediments and turbidity do not adversely affect fish and shellfish resources in the harbor and fishery resources near aquatic disposal sites, if such sites are used.

4. That, if shockwaves, sediments and turbidity do in fact cause fish kills and/or losses in shellfish, plans be made in the project document to cease work and develop a new operating schedule and/or methods.

We hope our comments will be helpful. Please keep us informed as your plans develop.

Sincerely yours,

Gordon E. Beckett

Gordon E. Beckett
Supervisor

CITY OF BOSTON

KEVIN H. WHITE
MAYOR

MICHAEL WESTGATE
Executive Director

May 3, 1978

Department of the Army
NE Division, Corps of Engineers
424 Trapelo Road
Waltham, MA 02154

Attn: Mr. U.R. Cochiarella
Coastal Development Branch

Dear Mr. Cociarella:

The Economic Development and Industrial Corporation has prepared a long run forecast of ship repair work at the Boston Marine Industrial Park. This information presented below should be helpful in your planning for the dredging project for Boston Harbor.

Projected Annual Occupancy, Drydocks #3 and 4
Class of Ship by Displacement Tonnage

	Under 30,000	30,000-80,000	Over 80,000	Total
1980	10	8	5	23
2000	14	11	7	34
2025	12	14	11	37

Dollar Value of Projected Repair Work in Millions

	Under 30,000	30,000-80,000	Over 80,000	Total
1980	6.45	17.20	12.75	36.40
2000	9.03	23.65	17.85	50.53
2025	7.74	30.10	28.05	65.89

Factors to be considered in long range forecast:

1. Overall growth of Port traffic.

   - addition of new container port facilities.
   - increased size of commercial ships

- cumulative effect of increased port traffic. Increased capacity for handling ships, induces carriers to utilize port facility on a more regular basis.

2. Growth in Repair Work.

- major improvements to Drydock facilities underway, which will increase efficiency and hence marketability. (Including $1.8 million for Drydock #3 in 1978 and $5.0 million to Drydock #4 by 1980.
- Drydock #3 is the second largest drydock on the East Coast - 1276' feet in length and 43' in depth over sill at high tide.
- Capability of Drydock #3, due to proximity to open ocean and shipping lanes, to handle emergency type repairs. Also, the Port of Boston is one full sailing day closer to Europe than any other American port.
- Increased reliance by U.S. Navy on private repair yards to all categories of its repair work.
- With rising cost of new vessel construction there will be a greater reliance on routine maintenance, by commercial carriers, as well as the U.S. Navy.

Very truly yours,

John Woronka
Assistant to Director

JW:jm

Boston Marine Society
Oldest Marine Society in the World
Organized 1742 — Incorporated 1754
470 ATLANTIC AVENUE
BOSTON, MASS. 02210
426-6445

December 27, 1977

Department of the Army
New England Division
Corps of Engineers
424 Turnpike Road
Waltham, Massachusetts 02154

Dear Sirs:

The Boston Harbor Navigation Study, as outlined by your office at a public meeting held on 14 December 1977, has been carefully reviewed by the Boston Marine Society (founded 1742).

It is the considered view of the Boston Marine Society that the long range effect and economic benefits of this plan will be of inestimable value to the Port of Boston and the port community. Accordingly, the Boston Marine Society speaking for its entire Marine membership whole-heartedly endorses the proposed dredging and improvement of the harbor without reservation.

In the event of any future hearings pertaining to this matter the Boston Marine Society would be most interested to attend or be of assistance in whatever way possible.

Very truly yours,

BOSTON MARINE SOCIETY

Captain Harold F. Lynch
Secretary/Treasurer

HFL:KFH

THE COMMONWEALTH OF MASSACHUSETTS
PILOT COMMISSIONERS
470 ATLANTIC AVENUE BOSTON 02210
DISTRICT ONE

27 December 1977

Department of the Army
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, Ma. 02154

Gentlemen:

At the Public Meeting concerning a navigation study in Boston Harbor, Massachusetts held on 14 December 1977 at 57 Park Plaza, the State Pilot Commission went on record endorsing the harbor improvements as outlined in the Corps' announcement dated 14 November 1977 with some minor changes.

The State Pilot Commission feels that the approach to Finn's Ledge as outlined is probably adequate under most conditions; however, we feel that the North Channel from Finn's Ledge to President Roads could be 42' deep at mean low water for the full width of the existing channel.

The Main Ship Channel of Boston Harbor as outlined in your announcement is, for the most part, an excellent piece of work; however, we feel at the turn at the west end of the anchorage in the vicinity of Buoys #2 and #4 should be widened on the starboard side inbound, and the channel should be made 40' deep for the full dimensions to a point off the Fish Pier. The rest of the project from the Fish Pier to the confluence of the Mystic River and Chelsea Creek and the Mystic River and the Reserve Channel with its outer turning basin are all in line with the thoughts of this Commission.

This Commission would be very happy to participate in any future meetings prior to your final submission of the project through Congress for the allocation of necessary funds to see the project through.

Yours truly,

Arthur M. Knight
Pilot Commissioner

AMK:bq

Boston Towboat

Boston Tow Boat Company
One Beacon Street
Boston, Massachusetts 02108
(617) 742-9200
Cable and Radio Address
"TUGBOATS" BOSTON

27 December 1977

John P. Chandler, Colonel, CE
Department of the Army
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, Ma. 02154

Dear Colonel Chandler:

It was good to see you at the hearing at Park Plaza on 14 November, and I was happy to be present to appear in favor of harbor improvements.

For the most part, the presentation by your people outlining their thoughts of harbor improvements is most acceptable; however, we do have a problem with the width of the channel from President Roads to Commonwealth Pier, as we feel that it should be 40' deep at mean low water for the entire existing project width.

I would be most happy to meet with any of your people to expand on our ideas.

Warmest best wishes.

Very truly yours,

BOSTON TOW BOAT COMPANY

David S. Walker
Manager

DSW:bq

UNION TANKER CORPORATION
(DOMESTIC MARINE TRANSPORTATION)
UNION WESTERN TRADE CORPORATION
(WESTERN HEMISPHERE BULK PETROLEUM ACTIVITY)
UNION OIL TRADING & SHIPPING LIMITED, BERMUDA
(INTERNATIONAL BULK PETROLEUM ACTIVITY)

December 22, 1977

Division Engineer
U.S. Army Engineer Division
New England
424 Trapelo Road
Waltham, Massachusetts 02154

Gentlemen:

Union Petroleum Corporation strongly supports the proposal to deepen the existing 35-foot Main Ship Cannel to 40 feet to the upstream limit in the Mystic River.

Deeper draft harbor facilities are essential if Boston and New England are to keep abreast and take advantage of ongoing marine developments such as the ever increasing size of petroleum tankers. Within a two-year period Union will have a petroleum storage facility along the Mystic River that will be able to take advantage of using 100,000 DWT tankers when the Mystic River is deepened to 40 feet MLW. The potential freight savings of delivering New England's much needed petroleum requirements in 100,000 DWT vessels is substantial. Depending upon the source of supply, savings could be as high as 30 cents per barrel. Assuming that 6 to 10 million barrels of petroleum products will be delivered to Union's Mystic River pier facility, the cost benefits flowing from the Union facility to the Boston/New England area could be as high as $3 million annually.

Replacing the 30/35,000 DWT tankers that presently deliver most of the petroleum products to Boston Harbor with 100,000 DWT vessels should result in a reduction in port congestion and minimize the probability of oil spills, thus substantially reducing environmental hazards. The larger vessels would, in general, be newer and better equipped, and this again would have favorable environmental effects.

Much has been said and written about the extrme dependence New England has on petroleum products brought in by sea. The proposed project to deepen the harbor, while it would not reduce that dependence, would recognize the fact that for the foreseeable future, lowering the cost of petroleum products delivered by sea is critical to New England's economy.

Very truly yours,

Gerald D. Battles
Senior Vice President

GDB:CS

BOSTON PILOTS
66 LONG WHARF — BOSTON, MASS. 02110
TEL. (617) 227-3575

Improvement Dredging Dept.
U.S.Army Corps Of Engineers
424 Trapelo Road
Waltham, Mass.

December 22, 1977

RE: Boston Harbor Dredging Proposal

Dear Sirs:

The Boston Pilots have the following comments to make on your proposal on a sector by sector basis beginning from seaward and proceeding into the inner harbor.

1) FINN'S LEDGE AREA

While recognizing the financial constraints imposed by the extensive areas of ledge bracketing the North Channel entrance,we feel that dredging the channel entrance to 45' for the present 1100' width is a minimum prerequisite for the size and draft of the anticipated shipping , particularly in heavy weather. We would hope that a study of the ledge area would lead to a further widening of the channel entrance. Meanwhile the present channel width will restrict this area to one way traffic only during certain weather conditions and instances involving large vessels meeting head and head.

2) NORTH CHANNEL AREA

We do not feel that the North channel should be deepened to 45' for a width of 1000' that includes the existing 900' wide, 40' sector. Since the inner harbor will have a controlling depth of 40' generally, which will dictate the timely use of the North channel, no significant benefit willaccrue from the 45' depth. The diminished practical width of the North channel will further restrict safe, two-way passage of large ships under certain conditions. Maximum benefit to shipping would be best served by dredging the entire 1500' width of the North channel inside a line perpendicular to the Main channel axis at Buoy #4 to a depth of 42' up to Buoy #10.

3) PRESIDENT ROADS ANCHORAGE #2

It is axiomatic that somewhere along the inbound route of large, deep_laden vessels into an inner harbor,that there exist an anchorage

and,or a turning basin with the capacity for anchoring and turning such ships in the event of mechanical failure, insufficient tug support or dense fog. An exception to this concept would be the case wherein tugs would accompany the ship along the entire route. Even this procedure would not be an appropriate response to the reduced visibility situation. To ignore the anchorage problem in a time of heightening governmental attention to safe vessel movement is to deny the obvious mandate of the Congress in this field. No anchorage work means reduced economic benefits from the overall plan and questionable safety considerations.

Therefore we strongly recommend that President Roads Anchorage#2 be deepened to 45' over its entire dimensions. This depth will also benefit the oil companies, who will be able to increase their lightering operations in the anchorage. If the cost of such a deepening is prohibitive, then as an absolute minimum, the Easterly half of the anchorage alone must be deepened to 45'.

4) MAIN CHANNEL-SPECTACLE ISLAND TURN

The proposal to increase the width of the 40' deep sector of the main channel at Spectacle Island turn from its present 600' width to 1000' in width does not address the following operational factors on large ships.

a) The ships are being pushed along by the incoming tide.

b) The pilot is trying to materially reduce speed at this point.

c) Many ships are taking tugs alongside at this point, prior to backing into the Reserve channel just ahead.

d) The ships lose steerageway and are pushed toward Dorchester Bay because of the tidal impetus.

e) The ships move laterally across the channel into the path of outbound traffic.

f) The ships are "pinned" against the Westerly bank of the channel requiring a sharp acceleration to lift the ship off the bank.

g) The ship is then going too fast for the tugs to check its way and turn the ship for docking in the Reserve channel.

The turn must be initiated high on the Northwest side of the channel so as to make a safe, slow swing. A large, deep ship could not use

the 300',35' deep sector, nor navigate within 100-150' of its unmarked border. We feel strongly that the channel must be dredged to 40' over the entire 1200' width at the turn and an additional area on the Northwest side of the channel widened and deepened to 40' to provide an overall width of 1500' at the center of the turn.

5) MAIN CHANNEL AND RESERVE CHANNEL TURNING BASIN

The Corps'proposal on the Main channel depths and widths presents a variety of complex considerations for the pilot.

a) If the main channel is dredged for a 1000' width with an unmarked border, large ships will have to keep clear of the invisible shoal sector, thus holding near the center line of the channel.

b) The Main channel must be 40' deep for the entire width of 1200' in the area opposite the turning basin off the Reserve channel because the present day ships turning stern first into the Reserve channel, already use the full width . With ships berthed alongside Castle Island Terminal, larger ships swinging on the flood tide must have the full width of the channel for maneuvering before the tugs can control the ship's advance.

c) Since the Spectacle Island Turn and the area opposite the turning basin must be dredged to the full width, then the small sector between them should also be deepened and widened to the 1200' width.

Our thoughts on the 1000' wide dredged channel area between the Reserve channel and Commomwealth Pier are as follows:

a) The creation of an invisible area of 35' water along the Northeast border of the Main channel effectively reduces the channel width to a working width of 850-900',since ships must give this area sufficient clearance. The idea of reducing the channel width by moving in the buoys is an unacceptable tradeoff in terms of safety.

b) Without additional tug assistance, the larger ships will have to pass further down in the lower harbor in the straight reaches.

c) The proposed container berths in South Boston will attract larger and deeper "box" ships. The maneuvering of these ships off the new facility would be enhanced by deep water over the entire 1200' width .

d) The effective narrowing of the Main channel for deep draft vessels will increase the difficulty in turning large ships in the event of emergencies or tug and bridge problems.

This proposal will require increased insistance on tugboat availability, proper visibility and co-ordinated communications with other ships.

We recommend that the Main channel be dredged to 40' over its entire 1200' width up to Commonwealth Pier.

Above Commonwealth Pier, the tug docking masters take over the "con" on most ships. Therefore we defer to these men in determining a proper maneuvering width of the Main channel in the sector above Commonwealth Pier up to the old Charlestown Navy yard.

The need for an enlarged turning basin for big gas, bulk and oil ships below the Mystic River Bridge is obvious because of the restricted width of the Mystic River, above the bridge itself.

The project is badly needed to provide sufficient width and draft for the modern, more economical , bigger ships now available. These costly vessels are practical only if the tide and weather delays can be reduced by improving our channels. However important are the economic factors, the safe operation of these larger ships in confined water must be kept in proper perspective and a reasonable proportion of the total expenditures must be designated to critical areas directly related to safe navigation.

Sincerely,

William T. Mitchell

Boston Pilots

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

EVELYN F. MURPHY
SECRETARY

December 14, 1977

Col. John P. Chandler
Department of the Army
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, MA 02154

Col. Chandler:

Thank you for the opportunity to comment on your proposed deep-draft navigation improvement project in Boston Harbor. I am generally in favor of this work, and appreciate its importance to the economic viability of Boston as a port facility. However, during the course of the review of this proposal by the various agencies within Environmental Affairs, several questions were raised which must be answered before the environmental impacts of this work can be properly evaluated.

Although the Corps has specified the amount of dredge spoil to be generated by this work, it has not yet been stated what the relative volumes will be of clean and polluted spoil. A detailed analysis of the physical and chemical characteristics of the dredge material should be provided. If there are substantial amounts of unpolluted material involved, the Corps should examine the possibility of disposing of this somewhere other than in the Foul Area. If this is not possible, there should be some consideration given to using the cleaner material as a cap over the more polluted dredge material

Rather than assume that all the dredge material will have to be disposed of, the Corps should consider the possibility of using this as a resource. The possibility of using all or part of the material in local construction projects should be evaluated, as should the possibility of using this material to construct an artifical island suitable for use by tern colonies.

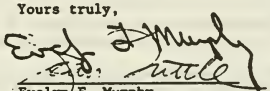
The dredging program should be carried out in such a way as to minimize adverse impacts on fish, wildlife, and recreation. The Corps should coordinate with the Division of Marine Fisheries to

discuss specific ways to minimize impacts on fish in the area, such as timing work to avoid critical seasons, and setting off blasting caps to scare fish out of the area before setting off larger charges. The Department of Environmental Management's Division of Forest and Parks should be consulted so that impacts on the Boston Harbor Islands State Park, an important state recreational resource, may be minimized. To prevent the deposition of dredged material in unauthorized areas, the Corps should institute an inspection and enforcement program to eliminate the recurring problem of short dumping.

Finally, the Metropolitan District Commission maintains major water and sewer lines which traverse Boston Harbor and which might be impacted by the dredging project. Close coordination with the MDC will be necessary to ensure that there is no interference with these vital services. Furthermore, the MDC at some point in the near future will be calibrating a water quality model of Boston Harbor, and excessive turbidity associated with the dredging could interfere with this. The Corps should go over their timetable with the MDC in an effort to avoid this interference.

I am confident that the proposed dredging can be carried out in an environmentally acceptable manner. I and the agencies in Environmental Affairs look forward to working with the Corps on this project.

Yours truly,



Evelyn F. Murphy

EFM:LF:jmdi

Boston Fuel Transportation, Inc.

MARINE TRANSPORTERS OF BULK PETROLEUM PRODUCTS

36 NEW STREET
EAST BOSTON, MASS. 02128
617-567-9100

14 December 1977

Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road,
Waltham, Mass. 02154

RE: NEDPL-C dtd 11-14-77

Gentlemen:

The following comments are submitted in connection with the Navigation Study in Boston Harbor, Massachusetts as outlined in your Notice of A Public Meeting dated 14 November 1977:

a. Boston Fuel Transportation Inc. has been operating in Boston Harbor for over 40 years. Approximately 100 people are employed.

b. The Company is in the business of transporting petroleum products in bulk for the oil companys in the harbor throughout New England.

c. The proposed dredging will go alo ng way towards improving navigation in the harbor. This will re sult in a definite improvement of the economic condition of the port.

d. For the most part I concur with what the Corps intends to do. However, there are several areas of the dredging that raises some concern to many of us that use the harbor. Accordingly, the following suggestions are offered:

1) I believe the proposal of hav ing a channel with two different depths as suggested by the Corps from the first bend in Broad Sound to President Roads creates a dangerous and unwarranted situation for navigators. In lieu thereof, it is recommended that a channel 1500' wide with a depth of 42' be considered. I believe this is more realistic and will allow the vessels to use the entire width of the channel at all times.

2) In the Main Ship Channel between buoys 2 & 8, more room to navigate is definetly needed north of the present channel. It is recommended that a line be drawn between buoys 2 & 8 and the channel below that line be dredged to a depth of 40'.

3) Anchorage #2 should be dredged to a depth of 45'. This will allow the anchorage to handle a vessel that might in an emergency be forced to use the anchorage.

Hopefully the Corps will favorably consider these suggestions. More details can be provided concerning these suggestions if needed.

Very truly yours,

John F. Curry, General Manager

BOSTON EDISON COMPANY
225 FRANKLIN STREET
BOSTON, MASSACHUSETTS 02110

December 14, 1977

Colonel John P. Chandler, Division Engineer
U.S. Army Engineer Division, New England
424 Trapelo Road
Waltham, Massachusetts 02154

Subject: Navigation Study in Boston Harbor, Mass.

Dear Colonel Chandler:

This letter is in response to "Announcement of a Formulation Stage Public Meeting concerning a Navigation Study in Boston Harbor, Massachusetts" dated November 14, 1977 and the meeting to be held on December 14, 1977 at the 57 Park Plaza in Boston, Massachusetts. The two resolutions and their potential benefit to Boston Edison Company customers, if implemented, mandates our unqualified support.

In essence the two resolutions are based upon the deepening of the existing 35 foot Main Ship Channel to a depth of 40 feet and the extension of dredging to the upstream limit in the Mystic River.

The Boston Edison Company is in agreement that the modifications, as described, to the Boston Harbor and Mystic River be performed in its entirety and at the earliest possible time for reasons that will be evident to all parties concerned.

The primary reasons for endorsement of this project are those of economy, reliability and efficiency of electric power generation to the customers of the Boston Edison Company.

Historically, the Northeastern segment of the United States and specifically Massachusetts has been known to have high electric costs due in large measure to importation of large amounts of fossil fuels such as coal and oil for generation of electricity. The Boston Edison Company has several generating plants which require oil as the prime source of fuel. The most economic method of obtaining fuel oil to satisfy generating capacity is to purchase it in large quantities and deliver it in large tankers. The Boston Edison Company has been limited in its ability to do this in the Mystic River area because of dock facilities and channel depth in this area. Upon approval and final completion of the prescribed dredging, Boston Edison Company has plans to upgrade dock facilities to accommodate larger tankers; so that, the substantial savings can be passed on to the customers of the Boston Edison Company.

By being able to dock and unload larger vessels as a result of the improved channel depth, the Boston Edison Company would now be able to participate in a larger oil procurement market. This flexibility will improve the overall reliability of supply to our generating stations. Access to a larger tanker market along with additional storage facilities would also permit Boston Edison Company to continue to maintain reliable electric power in times of potential oil shortages.

Upon completion of the dredging proposal, greater efficiencies in power generation at Mystic Station could also be realized. This plant uses salt water from the channel for cooling the condensers on steam electric generators. In this process cooler water is taken into the condensers and while condensing exhaust steam the cooling water is heated and released at a higher temperature. The final dredged depths at these locations could result in more efficient cooling performance and improved thermal dispersion.

The Boston Edison Company is required by various regulatory agencies to obtain permits relating to water use as well as dredging and disposal. As part of these permit approvals there are requirements for pre-operational and post-operational marine ecology and water quality studies as well as thermal dispersion studies. In some instances, these studies refer to existing plants as well as to proposed ones. Several studies of this nature have been conducted at generating plants in some of the affected dredging locations. The Boston Edison Company would be pleased to make available to the Corps of Engineers any of these studies which might prove beneficial for analytical purposes.

In summary, we realize the significant social, economical and environmental implications of a project of this scope as well as the circuitous path of permit approval. However, the Boston Edison Company feels that the best interests of the consumers of electric power in this area will be served with the speedy approval and ultimate completion of the dredging of the Mystic River Area and Boston Harbor.

Very truly yours,

R A Howard

R. A. Howard
Purchasing Agent

JJF/dc

Distrigas of Massachusetts Corporation

18 Rover Street
Everett, Massachusetts 02149
Tel (617) 423-5959

Everett Marine LNG Terminal

December 14, 1977

Colonel John P. Chandler, CE, U. S. Army
Division Engineer
U. S. Army Engineer Division, New England
424 Trapelo Road
Waltham, Massachusetts 02154

Re: Navigation Study in Boston Harbor, Massachusetts;
NEDPL-C Dated November 14, 1977

Dear Colonel Chandler:

This is to advise that Distrigas supports fully the concept of a channel depth of forty feet (40') minimum at Mean Low Water (MLW) from Broad Sound North Channel through and including the Mystic River as set forth in the preliminary proposal. To the extent that it does not impair the viability of the project, Distrigas would also support those recommendations of the Maritime Association of Greater Boston whose views are representative of the ship handling community and should be considered very closely.

The specific economics of the project vis a! vis the impact of the project upon LNG shipping to the Distrigas LNG Terminal are already contained in the project study. Distrigas would further submit that while a considerable margin of LNG shipping safety is built into the existing situation in Boston Harbor, the effect of the proposed project would further enhance this area in a favorable manner. This would manifest itself in an "intangible gain" in terms of the safety of the public..

In the broader sense, Distrigas envisions numerous economic advantages accruing to the public with minimal adverse impact environmentally. To this end, Distrigas would lend its full support toward the timely implementation of this project.

Very truly yours,

George B. Auchy
Terminal Manager

GBA/pbm

MASSACHUSETTS TURNPIKE AUTHORITY
SUITE 3000, PRUDENTIAL CENTER
BOSTON, MASSACHUSETTS 02199

JOHN T. DRISCOLL, CHAIRMAN
ALBERT P. MANZI, VICE-CHAIRMAN
DAVID R. NAGLE, MEMBER

536-1400

RE: NEDPL-C

December 13, 1977

Division Engineer
U.S. Army Engineer Division, N.E.
424 Trapelo Road
Waltham, Massachusetts 02154

Gentlemen:

This is in response to your November 14, 1977, ANNOUNCEMENT OF A FORMULATION STAGE PUBLIC MEETING CONCERNING A NAVIGATION STUDY IN BOSTON HARBOR, MASSACHUSETTS, to be held December 14, 1977.

It is noted that the existing project under study provides for deepening the existing 35-foot Main Ship Channel at the crossing of the Callahan and Sumner Tunnels to a depth commensurate with the adjacent 40-foot Main Ship Channel.

We would prefer that the existing overburden on the tunnels not be disturbed. However, if sound engineering procedures can be devised for the removal of material over the tunnels that would provide a minimum cover of 10 feet and if the performance of such work will not disturb the tunnel structures in any way, we would have no objection.

Nevertheless, any acceptance by this Authority of procedures for deepening the channel over the tunnels would be made with the clear understanding that the Department of the Army would assume full responsibility and liability in connection with this effort.

We would appreciate this letter being made part of the record of the December 14, 1977, public meeting.

Very truly yours,

John T. Driscoll
Chairman
4B-27

WHITE FUEL Corporation • BOSTON, MASS 02127 • (617) 268-4500

December 12, 1977

Division Engineer
U. S. Army Engineering Division,
New England
424 Trapelo Road
Waltham, Ma. 02154

NAVIGATION STUDY
FORMULATION STAGE
BOSTON HARBOR, MA.

Gentlemen:

White Fuel Corporation, one of the largest importers of petroleum products into Boston Harbor, fully supports the U. S. Corps of Army Engineers' proposal to dredge Boston Harbor to -40' mlw, including the area referred to as the Reserved Channel.

This project will allow deeper draft vessels with larger carrying capacity to enter Boston Harbor. From the standpoint of petroleum products, a significant reduction in vessel movements will be achieved - reducing the potential for marine and environmental accidents. The inclusion of larger vessels will inherently improve the class vessels utilized as these larger vessels are newer with the latest safety equipment and constructed based on up-to-date technology.

We look forward to the approval of this project and trust that its completion can be expedited for the environmental well being of the harbor area, as well as for the economic considerations of those involved in waterborne commerce.

Respectfully,

R. H. Thibodeau
Manager-Operations

RHTrs

14 DEC 1977

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

NEW ENGLAND REGION
12 NEW ENGLAND EXECUTIVE PARK
BURLINGTON, MASS. 01803
(617) 273-7318

December 12, 1977

Colonel John P. Chandler
Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Chandler:

Thank you for the announcement of the public meeting concerning the navigation study in Boston Harbor (Reference: NEDPL-C). We have some concern with the potential impact of this project on flight operations at Logan Airport.

A segment of the Main Ship Channel from President Roads to the Fish Pier at South Boston traverses the obstacle approach area associated with the instrument landing system for runway 4R (accommodating landings toward northeast) at Logan Airport. A penalty is imposed on the minimum instrument flight descent altitude of airplanes approaching to land while vessels of critical height are in the critical area. Similarly, restrictions are placed on instrument flight departures in the opposite direction. Because of these constraints, and the possible need for additional ones, we are concerned about the size (height above water) of the vessels that will be involved in the dredging and, if of critical height, the length of time they will be in the critical area. Coordination will be required to assure safety of flight operations, and to minimize flight constraints.

There is also potential for conflict with instrument flight approaches to runway 33L (toward northwest). It is not clear from the information provided whether anchorage No. 2 boundaries are to be expanded. Should the present boundaries of this anchorage be extended toward Logan Airport, a serious conflict would occur with arriving aircraft using the instrument landing system on runway 33L and possibly aircraft departing the opposite direction.

Any encroachment on Logan Airport airspace could seriously derogate flight safety. We are concerned with the possibility, and will be pleased to offer technical assistance to your study. I can be reached at 273-7318.

If anchorage No. 2 is to be extended toward the airport or if dredging vessels or other equipment exceed the standards of Subpart C of Part 77, Federal Aviation Regulations, an aeronautical study will be necessary. To facilitate this I have enclosed two copies of FAA Form 7460-1. Instructions are included with the forms.

Representatives from this agency will attend the public hearing on December 14, 1977.

Sincerely,

DAVID L. RICKARD
Acting Chief, Planning and Appraisal Staff

Enclosure

MASSACHUSETTS TURNPIKE AUTHORITY
ENGINEERING AND MAINTENANCE
668 South Avenue
Weston, Massachusetts 02193

JOHN T. DRISCOLL, Chairman
ALBERT P. MANZI, Vice-Chairman
DAVID R. NAGLE, Member

April 2, 1976

Your File: NEDPL-C

Mr. Joseph L. Ignazio
Chief, Planning Division
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Re: BOSTON HARBOR - NAVIGATION STUDY

Dear Mr. Ignazio:

I have your letter of March 26, 1976, concerning the navigation study for deepening various portions of Boston Harbor.

As best as we can determine, there is a minimum cover of 10 feet over the tunnels. It appears from the profiles that the top surfaces of the outer shells of the tunnels are about 50 feet below mean low water.

An in-depth study would be required to determine what effect the removal of a portion of the cover material would have on the Tunnels. This study would have to include investigating those factors cited in the letter from John Wm. Leslie, Chief, Engineering Division, dated 16 February 1973, when a similar study was being undertaken by the Corps of Engineers.

As was indicated at that time in the reply letter from our Chairman, dated March 14, 1973, we are not prepared to undertake such a study.

We note from our records that in August 1967, when the harbor was dredged, a special effort was made to keep the dredge and spuds some 100 feet distant from the centerline of the Tunnels.

Unless we can be shown by sound engineering analysis that the cover material can be removed without detrimental effect, it is our position that the existing overburden on the tunnels shall not be disturbed.

We regret that we do not have information to furnish you regarding the tunnel design criteria.

4D-31

Very truly yours,

M. C. Crain
Chief Engineer

MCC/MA
C-JTD,WPD,JNG,EXH/Enc.

Bostongas

144 McBride Street
Boston, Mass. 02130
Telephone (617) 522-5600

Mr. Leon M. Rudman
Planning Division
U. S. Army Corps of Engineers
424 Trapello Road
Waltham, Massachusetts 02154

February 9, 1976

Dear Mr. Rudman:

This is to confirm our telephone conversation of January 28, 1976 in regard to Boston Gas' current and planned use of Boston harbor.

Although Boston Gas expects to increase its use of imported LNG and LPG, we currently plan to make all of our purchases from local suppliers who will make the actual imports. At present, Boston Gas is purchasing imported LNG from Distrigas Corp. and LPG from Exxon. Both of these purchases are subject to long term contracts.

While our present planning does not call for our direct importation of LNG, or feedstocks, the chaotic nature of the energy industry makes it almost impossible to project with any accuracy very far into the future. In fact, our policy must be to keep ourselves as flexible as possible in developing new supply sources. As a result, it is entirely possible that Boston Gas may have to involve itself in direct importation, even though that would appear unlikely at present.

Sincerely,

James H. Dodge
Manager, Planning Services

JHD/jfr

Seaport
99 HIGH ST BOSTON MASSACHUSETTS 02110 (617) 482 2930 TELEX 94 0065

November 17, 1975

Mr. F.N. Ciccone, Chief Navigation Branch
Operations Division
Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, MA. 02154

Dear Mr. Ciccone:

In response to your September 16, 1975 letter, we wish to advise your organization that the Federal Project for Boston Harbor as modified on October 23, 1962 is not adequate for 1975 ship traffic.

The project authorized thirteen years ago might have well served the purpose then, when much of the Seaport's foreign and domestic trade moved in the hulls of C-2, C 1-B, C-3, EC-2 (Liberty), C 1-M-AV 1, VC 2 (Victory), C-4 (Mariner) and "Exporter" type dry cargo vessels, and T-2 tankers. But within the past decade, revolutionary forward strides have been made in the area of ship design, size and technology. In the vocabulary of oceanborne transportation, new terms and acronyms, not heard of in 1962, have appeared, and now such expressions as "Containerships" - "Supertanker" - "LASH" - "SEABEE" -"VLCC" etc. have become household words in domestic and foreign waterborne operations.

In 1962, the average ship calling at Boston measured anywhere from 530 to 600 feet in length. Statistics show only 2% of the total ship arrivals that year (41 units) entered the harbor drawing 35 to 37 feet, with only one vessel loaded beyond 37 feet of draft. In contrast, oil tankers and containerships visiting the Seaport today are nearly 900 feet long and draw as much as 41 feet. In 1974, 19% of the total self-propelled vessel traffic (237 units) moved through Boston Harbor with a draft of 35 to 41 feet, with the emphasis being in the 38-39 foot range.

In many instances, deep draft vessels such as these are forced to transit the harbor area during daylight hours, and then only at periods of high water. Berthing delays awaiting favorable tidal conditions are costly, and no doubt have contributed to the decision made by some steamship accounts to curtail

or downright abandon service to the seaport. Foremost among our losses that can be attributed - in part - to inadequate channel depths are the lumber transporting bulk carriers originating out of northwest Canada.

In 1971, when lumber "tramp" services were provided by smaller vessels, Boston averaged three such ships a month. In 1974, when for economic reasons, the lumber operators were compelled to charter larger and deeper-draft bulk carriers, the seaport could no longer successfully accommodate them and despite the fact that, at its own expense, Massport dredged to 40 feet at MLW the area alongside Castle Island berths 11, 12, 13-14, the effort for the moment has been in vain since these particular ships cannot safely transit certain other areas of the Main Ship Channel where shoaling has occurred.

The Main Ship Channel, as a whole, was apparently modified around the defense logistic requirements of World War II. Undoubtedly, with the thought in mind of servicing outgoing heavily laden vessels supplying the various war zones, the starboard section of the channel was dredged to 40 feet at MLW while the portion leading into the harbor was maintained at 35 feet. In the last 30 years, however, conditions and needs have reversed, and today with 85% of Boston's total port trade moving in an inward direction, attention must be given to the "Red" part of the channel and steps taken to arrange the deepening of same to the level of opposite side of the stream.

When optimum conditions prevail, the Port of Boston Pilots have compensated for this disadvantage by favoring the deeper East Side of the North Channel when navigating an inbound, heavily laden vessel. Despite improved communications and a voluntary traffic reporting system, this practice is undesirable, and warrants immediate attention and change.

In the interest of Port safety and commercial development, we recommend that the following initial steps be taken by the Corps of Engineers to maintain, improve and modernize the principal bywater approaches to Boston's marine facilities.

1. Level all areas of the Main Ship Channel to the authorized project depth by smoothing out the shoaling that has occurred especially, but not limited to the area adjacent to the main waterfront where the presently existing depths at MLW are, at some points, only 32'. These shoal areas are indicated on Corps of Engineer survey charts of June 1972.

2. Cut out a turning and maneuvering basin 40 feet deep at MLW on the Mystic River beginning at the boundary of the U.S. Gypsum Dock, extending 1,100 feet

MASSACHUSETTS
BAY
TRANSPORTATION
AUTHORITY

500 Arborway, Boston, Mass. 02130

March 29, 1973

Mr. John Wm. Leslie
Chief, Engineering Division
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Leslie:

Re: Federal Navigation Project in Boston Harbor
NEDED-R -- Corps of Engineers

This will acknowledge your letter of February 26, 1973, wherein you advise of your current study regarding the feasibility of deepening the main ship channel in Boston Harbor from 40 feet to 45 feet.

In accordance with your request, our engineers have considered the possible effect on the East Boston rapid transit tunnel if the ship channel were deepened to 45 feet. We have concluded that any further reduction of cover would, perhaps, jeopardize the integrity of the tunnel. This opinion is based on the fact that at the time of final design and construction of the tunnel the main ship channel was approximately 35 feet deep. The tunnel was constructed with a cover of 18 feet, with the understanding that future dredging to a 40 ft. depth would be possible without endangering the tunnel.

Inasmuch as the main ship channel is currently 40 feet deep at mean low water, it is therefore considered that the existing cover over the rapid transit tunnel should not be further reduced, without first undertaking a comprehensive engineering evaluation. If the Corps of Engineers should proceed with such a study, the MBTA would be more than willing to review the various alternatives prerequisite to making a specific recommendation.

If I can be of any further assistance regarding this matter, please do not hesitate to call.

Very truly yours,

Joseph C. Kelly

Joseph C. Kelly
General Manager

upstream and 1,000 feet in a northerly direction towards the left bank, so that large containership calling at Moran Docks, as well as oil tankers and gastankers visiting Exxon and Distrigas respectively can be turned safely without having to back up into the Chelsea River, as it is the practice at this time.

3. Deepen the anchorage at President Roads commonly known as Anchorage #2 to the authorized project depth of 40' at MLW.

4. Begin immediately a feasibility study to justify the dredging of the entire breadth of the Main Ship Channel to 40 feet at MLW including those widths presently authorized at 35 feet at MLW.

5. And since we recognize that funding these projects is a long involved ordeal, in order to prepare for the distant future, we urge the Army Corps of Engineers to immediately get underway a study to prove practicable the dredging of the Main Ship Channel to depths beyond forty feet.

The Massachusetts Port Authority will be pleased to arrange office space for meetings, to provide the necessary leadership in the gathering of pertinent information from port users and entities, and to assist the Corps of Engineers on those situations in which our help might prove beneficial in starting the task of modernizing Boston's Main Ship Channel.

Yours very truly,

MASSACHUSETTS PORT AUTHORITY

Thomas F. Moakley

Thomas F. Moakley
Port Director

RM/pmm

a
l
m
s

AMERICAN INSTITUTE OF MERCHANT SHIPPING

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Pacific Regional Office
635 Sacramento Street, Suite 300, San Francisco, California 94111
Phone: 415/362-7986

August 3, 1970

Col. Frank P. Bane
Division Engineer
New England Division
U. S. Army Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02154

Dear Col. Bane:

BOSTON HARBOR AND MYSTIC RIVER CHANNELS, MASSACHUSETTS--
REVISED RECOMMENDED IMPROVEMENTS

On the basis of further disucssion with deep-draft navigation interests and Captain George R. Lauriat Jr., President of the Boston Pilots' Association, we have revised our recommendations with respect to the areas in which navigation improvements should be carried out in Boston Harbor and Mystic River. Our revised recommendations are set forth on the attached page 11 which should substitute for the similarly numbered page in our original statement which I presented at the public hearing you conducted in Boston on June 29. The following are the major points of difference between our revised and original recommendations:

(1) We are now recommending that the channel in Broad Sound from the sea to President Roads be deepened to 50 feet over its entire authorized project width of 1500 feet, instead of deepening only the port side of this entrance channel from 40 to 45 feet over the present 900 foot width of the 40-foot channel.

Captain Lauriat has informed us that if a 45 foot channel is provided in Boston Harbor, as we have recommended, it will be necessary to provide at least a 50 foot depth in the entrance channel through Broad Sound to more adequately accommodate vessels of deeper draft. The additional depth of 50 feet in the channel through Broad Sound is necessary to provide greater clearance under the keel in order to compensate for a greater degree of squat caused by pitching of deep-draft vessels, particularly large tankers, when there is a heavy sea running through Broad Sound Channel. This pitching action increases the draft of the ship by several feet at the bow. Heavy seas are prevalent in Broad Sound during winter months and at times during summer months. In addition, the depth of water in approaches to Broad Sound Channel is about 54 feet.

According to Captain Lauriat, the above situation makes it difficult to navigate deep-draft, large vessels within the limits of the existing 900 foot wide, 40 foot channel and that therefore, the additional depth should be provided throughout the entire project width of 1500 feet in Broad Sound Channel.

(2) You will note that we have now recommended that the inbound starboard side, instead of the port side, of the entrance channel from President Roads to a point opposite Fish Pier in Boston Harbor be deepened to 45 feet one-half the width of the channel, i.e. 600 feet. We have also recommended that a 45 foot access channel be provided to the Reserved Channel from the starboard or easterly side of the entrance channel. Our original recommendation for deepening the 40 foot channel on the inbound starboard side north of the Fish Pier to 45 feet remains the same.

You will recall that at the June 29 hearing, both Captain Lauriat and Mr. John J. Halloran, Manager of the Maritime Association of Greater Boston, stressed very strongly the need for eliminating the present situation in which Masters of inbound deep-draft loaded tankers and other vessels are compelled to navigate in the 40 foot section of the entrance channel which is on the port side. This is not in accordance with the Rules of the Road which stipulate that ships should adhere to the starboard side of the channel. Unfortunately, this rule cannot be followed by inbound deep-draft vessels in the entrance channels to Boston Harbor due to the fact that the 35 foot depth is on the starboard or easterly side of the channels in Broad Sound, and along the main waterfront up to a point off the Fish Pier.

AIMS and member companies operating vessels into Boston Harbor consider it most important that this situation be corrected so that the Rules of the Road may be adhered to in the interest of safe navigation. The present arrangement is fraught with potential collision hazards since both inbound and outbound vessels are navigating in the 600 foot westerly half of the channel along the main waterfront between President Roads and the Fish Pier. We therefore strongly urge prompt action to remedy this situation.

The favorable consideration of our revised recommendations will be very much apppreciated. The following typographical error should be corrected on Page 9 of our original statement: In the second paragraph delete "depths" where it appears on lines 4 and 6 and insert "drafts" in lieu thereof.

Sincerely,

C. Lincoln Cone, Assistant Secretary

Enclosure

C: Mr. John J. Halloran Manager, Maritime Association of Greater Boston
Captain George R. Lauriat Jr., President, Boston Pilots' Association
Mr. Edward King, Executive Director, Mass. Port Authority

(1) Deepen entire entrance channel in Broad Sound, commonly known as Boston North Channel, from the sea to President Roads from 35 and 40 feet to 50 feet over its present project width of 1500 feet.

(2) Deepen starboard side of entrance channel from President Roads to a point opposite the Fish Pier from 35 to 45 feet over its present width of 600 feet and deepen channel on starboard side north of the Fish Pier from 40 to 45 feet over its present width of 600 to 900 feet in the upper reaches up to the Mystic River (Maurice J. Tobin Memorial) Bridge.

(3) The port side of the entrance channel from President Roads up to the Fish Pier should be maintained at its present authorized depth of 40 feet.

(4) Deepen channel in Mystic River from 35 to 45 feet over a width of 600 feet extending from the upper limit of the Boston Harbor Channel at the Mystic River Bridge to a point 300 feet downstream from the Malden Bridge. The balance of the project width of the Mystic River channel, i.e. 400 feet, should continue to be maintained at 35 feet for turning and manuevering purposes, etc.

(5) Deepen Reserved Channel from 35 to 45 feet and provide access channel at same depth from proposed 45-foot entrance channel on starboard side.

(6) Consideration should be given to need and advisability of deepening President Roads Anchorage from 40 to 45 feet.

FINAL
ENVIRONMENTAL IMPACT REPORT/ENVIRONMENTAL IMPACT STATEMENT
(FEIR/S)
Volume 1 of 3

BOSTON HARBOR NAVIGATION IMPROVEMENT DREDGING AND BERTH DREDGING PROJECT

RESPONSIBLE LEAD AGENCIES ARE:

U.S. Army Corps of Engineers
Impact Analysis Division
424 Trapelo Road
Waltham, Massachusetts 02254

Massachusetts Port Authority
Maritime Department
Boston Fish Pier II
Boston, Massachusetts 02210

FEDERAL COOPERATING AGENCIES:

National Marine Fisheries Service, U.S. Fish and Wildlife Service, and the U.S. Environmental Protection Agency

DOCUMENT WAS PREPARED BY:

Normandeau Associates Inc.
25 Nashua Road
Bedford, New Hampshire 03310-5500
for the
Massachusetts Port Authority

U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254

This joint Federal and State document addresses the impacts associated with the Congressionally authorized navigation improvement dredging and disposal of material from the Federal navigation channel and associated berthing areas in Boston Harbor, Massachusetts. The Reserved Channel and Mystic River would be deepened from 35 feet mean low water (MLW) to 40 feet MLW. The Chelsea Creek would be deepened from 35 feet MLW to 38 feet MLW. Disposal of the underlying parent material is proposed at the Massachusetts Bay Disposal Site. Disposal alternatives for the silt material (maintenance material) overtopping the parent material are assessed and the preferred alternative selected in this FEIR/S.

Comments should be sent to Colonel Richardson at the U.S Army Corps of Engineers and Ms. Trudy Coxe, Secretary, Executive Office of Environmental Affairs, Commonwealth of Massachusetts by the date indicated in the transmittal letter. If you would like further information on this document, Mr. Peter Jackson of the U.S. Army Corps of Engineers can be reached at (617) 647-8861 or contact Ms. Janeen Hansen, Massport, at (617) 973-5355.

BOSTON HARBOR NAVIGATION IMPROVEMENT PROJECT

FINAL ENVIRONMENTAL IMPACT REPORT/STATEMENT

Volume 1

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BOSTON HARBOR NAVIGATION IMPROVEMENT PROJECT FINAL ENVIRONMENTAL IMPACT REPORT/STATEMENT

EXECUTIVE SUMMARY

Project Description

The Boston Harbor Navigation Improvement and Berth Dredging Projects (BHNIP) encompass the deepening of three tributary channels (Reserved Channel, Mystic River Channel and Chelsea Creek Channel) and two areas in the Main Ship Channel (Inner Confluence and the mouth of Reserved Channel) to provide sufficient ship maneuvering areas for the deepened channels; six berth areas that would benefit directly from the channel deepening (Conley 11-13, Prolerized, Distrigas, Moran, Eastern Minerals and Gulf Oil); and six berth areas and one intake structure that would not benefit directly from (i.e., be connected to) the channel deepening (Boston Army, Boston Edison Intake, Boston Edison Barge, Conley 14-15, Revere Sugar, Mystic Piers 1, 2, 49 and 50). The President Roads Anchorage Area and adjacent channels would be re-marked to enlarge the deep water anchorage without additional dredging. Deepening of the channels to -40 ft MLW (except Chelsea Channel to -38 ft MLW) would allow greater use of the hitherto underutilized -40 ft MLW Entrance Channel and Main Ship Channel (see Figure ES-1).

The improvements to the three Federal channels were proposed as a result of a Feasibility Study completed by the Corps of Engineers in 1988.. The three-channel project was selected as the economically and environmentally preferred project alternative. It was authorized by Congress in the Water Resources Development Act of 1990 (P.L. 101-640). The authorized project would allow the Port of Boston to maintain its competitiveness in the highly competitive national and international marine trade business by reducing the cost of transporting goods and thus improving efficiency.

Massachusetts Port Authority (Massport), as local sponsor of the project, submitted an Environmental Notification Form (ENF) to Massachusetts Executive Office of Environmental Affairs in April 1991. The Secretary's Certificate on the ENF required the preparation of an Environmental Impact Report (EIR) with three major areas of focus:

- sediment characterization,
- evaluation of disposal alternatives and
- a dredging management plan.

The Corps of Engineers, New England Division, committed to preparing an EIS in 1992 due to the cumulative impacts of Federal actions (maintenance dredging, navigation improvement dredging, and permitting of the associated berthing areas) and the significant public concern over disposal of dredged material. Because the channel improvement and berth dredging projects are intricately linked and

interdependent and would be reviewed by the same regulatory audience, it was determined that preparation of a joint Environmental Impact Report/Statement (EIR/S) would be most efficient.

A Draft EIR/S was published in April 1994. This FEIR/S is designed to respond to comments received on the Draft including the Secretary's certificate dated June 30, 1994 and to comply with the requirements for an FEIR as described in 301 CMR 11.07 (10). This document also serves to meet the requirements for an FEIS as specified in 40 CFR Part 1503. This document identifies a preferred dredging and dredged material disposal option, assesses the anticipated environmental impacts associated with each, identifies potential long-term disposal options that may be appropriate for maintenance dredging of the completed project, and responds to all comments received on the Draft.

Purpose and Need of the Project

Both the MEPA and NEPA regulations require a purpose and need statement that briefly specifies the underlying objectives and anticipated benefits of the project. The purpose of the BHNIP is to increase the navigational efficiency and safety of Boston Harbor for present types of deep draft vessels. This purpose was the basis for the 1988 Feasibility Report prepared by the Corps to conclude that the project was justified economically. There are also direct economic benefits that accrue to the Port from the BHNIP. These include: 1) increased navigational efficiency and safety by reducing the need to wait out tides or to decrease loads prior to entering the Harbor; 2) the ability to ship more tons of containerized cargo with fewer ships; 3) the ability to attract new shipping lines; and 4) ability to maintain vital refined oil products facilities and allow for double-hulled tankers.

Public Participation

Massport, the project's local sponsor, and the Corps of Engineers recognized the need to involve key agencies and groups in the planning process through consultation, information exchange and presentation of diverse viewpoints. In March 1992, Massport formally invited thirty-five federal, state and local agencies and public and private interest groups to participate in a project Advisory Committee. The Committee's function was to advise Massport and the Corps of Engineers in the overall design and planning of environmental studies which would form the basis of the environmental review. The Committee met seven times over the course of the studies leading to the preparation of this EIR/S.

Early in the public participation process two specific technical issues were identified as those which would benefit from a more focused analysis and review than that which could be provided by the Advisory Committee. As a result, two Working Groups were formed as subsets of the Advisory Committee to provide guidance and expertise in : 1) sediment characterization; and 2) disposal site identification and screening. Through the course of the project these Working Groups, and the larger Advisory Committee, provided valuable commentary on sampling and testing protocols and information on identifying and characterizing disposal sites. The Working Group process contributed in creating a dynamic and responsive work product by increasing the scope of the

sediment sampling and testing and expanding the types of disposal options and specific disposal sites to be screened for the project.

The Advisory Committee convened twice during the preparation of the FEIR/S, in September 1994 and March 1995. The Advisory Committee was instrumental in assisting the project team in identifying major areas of concern regarding the DEIR/S that required additional data collection or analysis in the FEIR/S. These consisted of a working group meeting in November 1994, focusing on developing a comprehensive data base of dredged material treatment and disposal technologies. A second working group convened in December 1994, focusing dredging performance standards and monitoring concerns that would be developed into a comprehensive Dredge Management Plan.

Public participation was also extended to public meetings, meetings with concerned interest groups, and the receipt of sixty-one comment letters from federal, state, and local agencies, commercial interests, private interest groups and private citizens. Public meetings were held in Boston, Hyannis and Nahant.

In addition to the public participation process, the project team also engaged in several meetings with the combined EOEA agencies. Meetings were also held between the Federal cooperating agencies and the Corps to address Federal issues concerning comments on the Draft EIR/S.

Sediment Characterization

The BHNIP will result in removal of approximately 1.1 million cubic yards (cy) of silt (as measured in-place). The total quantity of silt requiring disposal is slightly higher, 1.4 million cy, which accounts for 0.5 feet of over-dredging into the underlying parent material and a 20% expansion factor due to dredging. An extensive sediment sampling and testing program, developed interactively with the Sediment Characterization Working Group, was undertaken to characterize the dredged material. The surficial silt layer (or "maintenance" material) was found to contain varying concentrations of metals, polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and other organics. The sediment bulk chemistry data, in combination with test organism toxicity and bioaccumulation testing, indicated that the silt was generally unsuitable for unconfined open water disposal. It was further determined that the underlying sediment (parent material) was composed of clay and sand/gravel and has low levels of metals and organics. The Corps initially determined that approximately 360,000 cy of silt was suitable for ocean disposal. Using the same data, however, the EPA determined that none of the silt was suitable for unconfined ocean disposal. In response, the Corps adopted the more conservative position and assumed that all silt from the project is considered unsuitable for unconfined ocean disposal.

The underlying parent material, composed primarily of Boston Blue Clay with gravel pockets, has been shown on this and other projects to be uncontaminated and suitable for unconfined open water disposal. The total volume of approximately 2 million cy of parent material (including the expansion factor) can be disposed at an unconfined open water site if no beneficial uses (e.g., landfill and/or capping) are identified. The final component of the dredged material is

rock that would be removed from Mystic River Channel and two areas of the Main Ship Channel. Beneficial uses considered for the 132,000 cy (post-dredging volume) of rock included habitat enhancement or armoring disposal sites that are subject to high-energy hydrodynamics.

In addition to addressing the dredged material disposal needs for the BHNIP itself, disposition of the future maintenance of the deepened channels over the 50 year project life was addressed. The estimated 4.4 million cy of future maintenance material would be composed primarily of silt. For the purpose of the disposal alternatives analysis, it has been assumed that this material could contain elevated levels of contaminants. Under this assumption (which may or may not be the case), the material would have to be deposited in a confined disposal site.

Disposal Alternatives Analysis

A Disposal Options Working Group was convened to develop criteria for evaluation of the universe of potential disposal sites and beneficial uses of parent material, rock, silt and future maintenance dredging material. The group participated in the disposal site selection process at regular intervals, reviewing arguments for retaining or eliminating specific sites. The short list of potential disposal alternatives included sites in two major categories, land-based and aquatic sites, and eight subcategories: landfills, land-based inland, land-based coastal, aquatic shoreline, aquatic subaqueous, aquatic borrow pit, existing aquatic disposal sites, in-channel disposal and treatment technologies.

The disposal alternatives analysis screening process was comprised of four phases. In the first phase, comparisons were made using evaluation criteria among sites within each alternative category (i.e., landfills were evaluated together but not compared to aquatic shoreline sites). A subsequent evaluation focused on regulatory and other limiting criteria to select the sites which provided the least environmental impact with the greatest project benefit. Sites were then screened for practicability issues of cost, logistics and technology in relation to project needs and goals.

In response to comments on the DEIR/S, the site screening process was re-visited. Additional data collection activities, performed after publication of the DEIR/S, were used to upgrade the data base upon which the sites would be evaluated. A confirmatory aquatic sampling program was undertaken in October 1994 to assess fin fish, benthic and lobster resources at the aquatic disposal sites. Fate and transport modeling to determine sediment load and contaminant transport was performed for all aquatic disposal options. In addition, agency files and resources were used to update and upgrade the information on the land-based sites. This fourth-phase screening process narrowed the list of practicable alternatives from an initial list of 376 sites and eight treatment technologies to 24 sites.

The development of disposal options next focused on combining sites to meet the capacity requirements of the project. This evaluation emphasized the fact that few sites are large enough to accommodate the disposal needs of the BHNIP by themselves. Finally, an environmental and practicability evaluation of options led to the identification of the in-channel disposal option. This option disposes of silt within the dredging footprint of the Mystic and Chelsea Rivers and the Inner Confluence in cells constructed in the parent material that are

capped with sand after filling. The in-channel option resolves concerns expressed on the DEIR against a "monofill" site by combining three sites (the Mystic and Chelsea Rivers and the Inner Confluence Area), confines impacts to the dredging footprint, and is rated the least environmentally damaging practicable alternative (LEDPA).

In response to agency comments on the DEIR/S, the project team has been asked to identify a secondary preferred alternative site for excess silt capacity should the preferred alternative fail to provide sufficient capacity after the project is underway. Based on the environmental and practicability screening process mentioned above, the Little Mystic Channel has been identified as a secondary contingency site. This site would be filled to mean low water, changing approximately 15 acres from a subtidal, but degraded condition, to intertidal habitat with clean substrate. This option provides approximately 373,000 cy of contingency capacity. If this site is required for secondary capacity, mitigation for change in substrate will be discussed with the appropriate resource agencies.

Parent material, not expended through a beneficial use, would be disposed at the MBDS. Rock will be available to cap the in-channel locations that may be subject to impacts from propeller wash, or it will be made available for another beneficial use. The remaining rock will be disposed of at the MBDS.

The FEIR/S also provides a disposal site selection process for maintenance dredging over the 50-year life of the project, or the maintenance material dredged even if the proposed navigation improvement project is delayed or not implemented. Maintenance dredging of accumulated silt material will be needed to allow ships to transit the harbor safely. Unlike the navigation improvement project, maintenance dredging would not produce clean parent material which could be used for capping. Therefore, disposal options which provide cap material, such as the Meisburger sites and Spectacle Island CAD, are preferable. Disposal could occur at other sites if suitable cap material can be found from other projects. The use of an aquatic site for maintenance dredged material would be subject to a lengthy site designation process. The Corps may be performing a demonstration of capping when suitable material becomes available so that the Massachusetts Bay Disposal Site can be used for maintenance material.

Effects of the Project

Certain short-term adverse effects of the project would be unavoidable. Some benthic organisms and demersal fish would be killed during dredging and blasting. Substrate in the areas dredged would be temporarily devoid of benthic organisms but would be recolonized in approximately one year, reforming habitat with prey suitable for fin fish. Turbidity would increase temporarily in the area of the dredge. Use of an environmental (closed) bucket will help minimize contaminant release. Other turbidity controls, such as silt curtains, will be assessed in terms of suitability depending on the location of the dredging operation. Close monitoring of the dredging operations, to identify problems and quickly seek corrective measures, will be undertaken.

The anticipated dredging rate would generate approximately two to four barges per day, depending on whether one or two dredges were operating and the size of the barges. Thus barge traffic should not

noticeably impede normal ship traffic; interference with navigation would be minimized by coordination with the Coast Guard.

Impacts due to disposal of dredged materials are temporary since they do not permanently alter the substrate of the in-channel areas. Also, in-channel disposal impacts remain within the footprint of the dredging so that resource areas outside the navigation channels are not impacted except for temporary turbidity impacts.

During the 1½ to 2 year dredging process non-motile benthic organisms utilizing the disposal areas would be buried. Recolonization should occur within one year after disposal operations are completed based on the existing benthic population of early successional stage organisms. Fin fish would tend to avoid the area during disposal due to noise and turbidity disturbances. The benthos and fish would eventually recolonize the dredge site and will benefit from the removal of contaminated silts. Important anadromous fish populations would be protected by suspending dredging and disposal in the Mystic River during the migration season.

The water column in the vicinity of the disposal site would experience increased turbidity following each disposal event. Approximately three to five percent of the silt/clay fraction would be lost to the environment during the disposal descent phase. Disposal simulation model evaluations indicated that disposal will not cause adverse exposure (i.e., exceedances of water quality criteria). The contaminant mixing zone, based on Total Suspended Solids (TSS) and PCB loads, has been calculated based on fate and transport modeling and will not interfere with fish passage and migration. Use of mitigation measures, such as silt curtains, to contain suspended solids and associated chemicals, are proposed as additional safeguards to minimize water quality impacts in the Harbor.

Secondary impacts of the project, consisting of land-side infrastructure impacts, Harbor traffic, and other socioeconomic interests, are minimal. The BHNIP will not significantly increase vessel traffic in the Harbor but will enhance navigational safety and maintain the competitiveness of the existing Port. Vessel traffic will continue to include a mix of large container ships, barges and tankers. The Seaport Access system, which is part of the Central Artery/Tunnel project, will result in more direct and convenient connections for trucks between port terminals and the regional highway network, thereby reducing traffic impacts on local neighborhoods. This roadway system is independent of the dredging project.

Dredge Management Plan

The FEIR/S has addressed the requirement for a Dredge Management Plan (DMP), as requested in the MEPA Scope. The DMP provides an overview of the dredging operations proposed for the project The key elements of the Plan include:

- a description of alternative dredging equipment and specific recommendations for this project;
- a description of dredged material disposal operations;
- a discussion of the sequencing of the dredging and disposal operations;
- an overview of potential

environmental impacts caused by these activities;

- proposed techniques for mitigating operational impacts;
- establishment of dredging performance standards;
- a description of recommended monitoring plans during dredging and for long term post-construction monitoring;
- and a discussion of potential operational contingency plans that would be implemented to assure the safe and successful completion of the project.

Cumulative Impacts

Cumulative impacts include all long-term maintenance requirements of the BHNIP in association with reasonably foreseeable long-ranged material disposal issues. These impacts also consider other actions in the Boston Harbor area that may have an impact on, or be impacted by, the project.

Selection of disposal sites for future maintenance dredging will be based on the environmental and practicability assessments provided in the MEPA/NEPA documentation. Factors affecting maintenance dredging sites include sediment characteristics and volume of material to be dredged. Sites that require site designation status, because of their capacity for numerous projects, would require lengthy permitting and detailed environmental assessment. Fast-track projects would have to look elsewhere for disposal. The disposal site for future maintenance of the BHNIP, and other Massachusetts projects, will be determined based on the appropriate environmental regulations and technical evaluations at that time. The New England Division Corps recommends, and will participate with the Commonwealth, in conducting an overall regional dredge material management plan for future maintenance of all of the Massachusetts Bay's harbors.

Two other large projects are currently under construction in Boston - the Deer Island wastewater treatment facilities upgrade and the Central Artery/ Third Harbor Tunnel (CA/T). The level of ship traffic generated by the BHNIP, its location relative to the Deer Island and CA/T projects, and the anticipated schedules for the three projects should result in minimal conflicts among the projects. The Massachusetts Highway Department expects that the placement of Third Harbor Tunnel excavate at Spectacle Island will be complete in 1995. As with other harbor infrastructure, coordination with the construction of the Third Harbor Tunnel would have to be carefully orchestrated. The BHNIP is expected to commence in 1997 and be completed in 1998. Coordination of ship traffic from each project with the U.S. Coast Guard will provide further safeguards. The Massachusetts Water Resources Authority (MWRA) anticipates substantial completion of the Deer Island plant upgrades by late 1995.

Water quality (and ultimately sediment quality) would continue to improve with the operation of MWRA's secondary treatment and offshore disposal facilities. The BHNIP and future maintenance dredging would continue to reduce the mass of contaminants in Boston Harbor even further.

Summary of Major Changes from the DEIR/S

Several issues were raised during the comment period that resulted in substantive changes from the proposed list of disposal alternatives presented in the DEIR/S. These issues were resolved as follows:

- Based on applicable environmental screening criteria, all silts generated by the project are considered unsuitable for unconfined ocean disposal.

- The MBDS, Subaqueous B and E, Meisburger 2 and 7, Boston Light Ship, and Spectacle Island CAD, have been eliminated from further consideration as practicable disposal sites for the BHNIP silt. These sites are still being considered as potential disposal locations for future maintenance dredging. Use of these sites for future disposal may require additional studies, demonstration projects, site designation, or the application of appropriate technologies.

- All parent material, consisting of sand/gravel, clay and rock, generated by the project is considered suitable for disposal at MBDS or for beneficial re-use, including use as a potential source of capping material for unlined municipal landfills.

- Technologies will continue to be assessed by the Corps for their potential applicability to future maintenance dredged material.

Cost considerations and capacity are no longer considered to be fatal flaws in disposal site screening. Cost is factored in only to assess the relative cost-effectiveness of disposal scenarios determined to be environmentally suitable and to determine practicability. Capacity is only one factor considered in site screening and combinations of sites of limited capacity may constitute acceptable disposal scenarios.

Federal and State Review

This FEIR/S will be reviewed by regulatory and resource agencies on the federal, state and local levels, as well as other interested parties for adherence to MEPA and NEPA guidelines and for addressing the issues raised in comment letters, at public hearings, and in the Secretary's certificate on the DEIR/S. Comments on this FEIR/S will be accepted by either the MEPA Unit at the Executive Office of Environmental Affairs or by the U.S. Army Corps of Engineers, New England Division. It is anticipated that the public comment period will be open until July 31,1995. Commentors are advised to contact these agencies directly to determine the actual date for the close of the comment period.

Federal and state permits and consistency reviews ultimately required for the project potentially include:

- U.S. Army Corps of Engineers
  - Section 10 of the Rivers and Harbors Act
  - Section 404 of the Clean Water Act

- National Marine Fisheries Service, U.S. Fish and Wildlife Service
  - Endangered Species Act/ Section 7 consultation

- U.S. Environmental Protection Agency
  - Section 404 and Endangered Species Act consultation
- Massachusetts Department of Environmental Protection
  - Water Quality Certification
  - Division of Wetlands and Waterways review of local Order of Conditions
- Massachusetts Office of Coastal Zone Management
  - Coastal Zone Consistency Review
- local Conservation Commission(s)
  - Order of Conditions

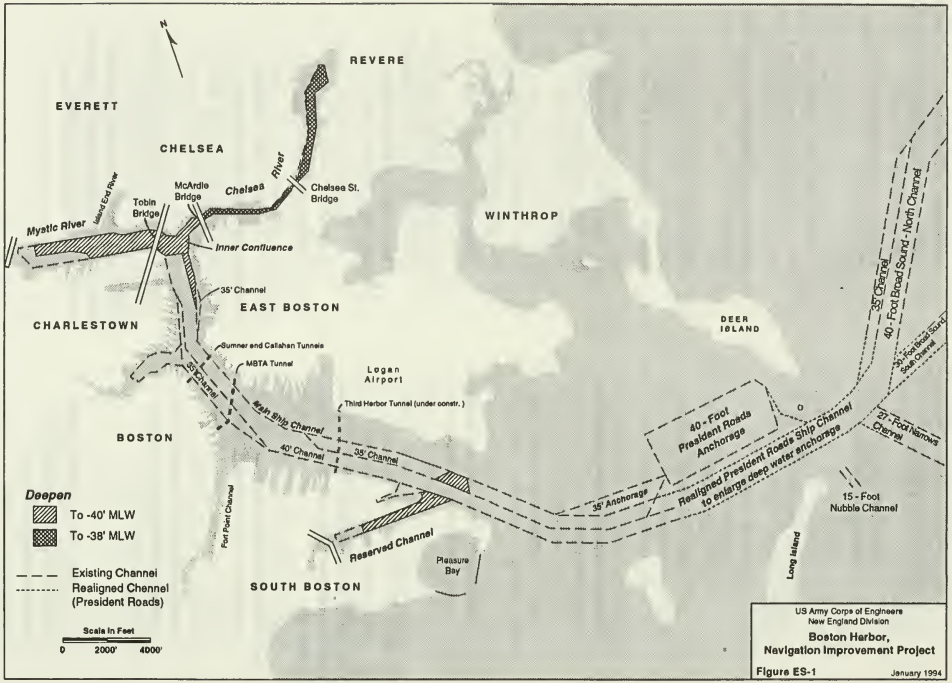
Format of the FEIR/S

This FEIR/S is comprised of three volumes. The first volume contains the main text and consists of:

- The procedural history, and purpose and need, of the project (Chapter One);
- A detailed project description and comparison of design alternatives (Chapter Two);
- A summary of the detailed process for screening sites for material disposal (Chapter Three);
- The environmental and practicability screening of a short-list of alternatives to determine the Least Environmentally Damaging Practicable Alternative (LEDPA) (Chapter Four);
- A detailed dredged management plan to describe the dredging and disposal operations and appropriate mitigation and contingency measures (Chapter Five);
- Mitigation concepts and proposals summary and opportunities for resource enhancement (Chapter Six);
- An assessment of the permitting and regulatory requirements the project must meet (Chapter Seven);
- A draft Section 61 finding to meet Massport obligations under 301 CMR 11.00 (Chapter Eight).
- A list of technical literature cited in this FEIR/S and a bibliography of references on Corps capping experience (Chapter Nine).
- A glossary of technical terms (Chapter Ten).

Attachment 1 to this volume contains detailed descriptions of the affected environment and project related impacts at the short-listed alternative sites.

Volume Two of the FEIR/S provides a copy of all comment letters received on the DEIR/S followed by a detailed response to each. Volume Three consists of appendices referenced throughout this FEIR/S.


N
REVERE
EVERETT
CHELSEA
Chelsea River
McArdle Bridge
Chelsea St. Bridge
Tobin Bridge
Mystic River
Island End River
Inner Confluence
WINTHROP
35' Channel
EAST BOSTON
CHARLESTOWN
DEER ISLAND
Sumner and Callahan Tunnels
MBTA Tunnel
Logan Airport
Third Harbor Tunnel (under constr.)
35' Channel
45ft Ship Channel
40' Channel
35' Channel
BOSTON
40 - Foot President Roads Anchorage
Realigned President Roads Ship Channel to enlarge deep water anchorage
35' Anchorage
21' Channel
35' Channel
40 - Foot Broad Sound - North Channel
35' Channel
15 - Foot Nubble Channel
Deepen
To -40' MLW
To -38' MLW
Existing Channel
Realigned Chennel (President Roads)
Port Point Channel
Reserved Channel
Pleasure Bay
SOUTH BOSTON
Long Island
Scale in Feet
0 2000' 4000'
US Army Corps of Engineers
New England Division
Boston Harbor,
Navigation Improvement Project
Figure ES-1
January 1994

Chapter One: Introduction

This document constitutes a joint Commonwealth of Massachusetts Final Environmental Impact Report and Final Environmental Impact Statement (FEIR/S) prepared by the Massachusetts Port Authority (Massport) and the U.S. Army Corps of Engineers (Corps). As a joint document, this FEIR/S meets the requirements of both the Massachusetts Environmental Policy Act regulations (301 CMR 11.00 *et. seq.*) implemented by the MEPA Unit of the Executive Office of Environmental Affairs, and the National Environmental Policy Act regulations (40 CFR Parts 1500 - 1508) also known as NEPA.

This document pertains in part to the Corps' Navigation Improvement and Berth Dredging Projects. These Projects were authorized by Congress in the Water Resources Development Act of 1990 (P.L. 101-640). This document also pertains to Massport in its role as local sponsor of the Federal project and for its planned berth dredging activities.

The MEPA regulations establish environmental review thresholds, a procedure, and a timetable for a two-level review process. The process generally begins when the project proponent, in this case Massport, files an Environmental Notification Form (ENF) with the Secretary of the Executive Office of Environmental Affairs (EOEA). Upon review of the ENF, the Secretary determines whether an Environmental Impact Report (EIR) is required for the project. The Secretary determined that the Massport project required an EIR in a certificate issued on June 7, 1991. An EIR is an informational planning document which serves to inform public decision makers, and the general public, of the environmental effects of the proposed project. As a planning tool, an EIR enables both the project proponent and agency decision makers to weigh environmental impacts and benefits prior to making decisions on permits, approvals or funding. The EIR is reviewed and commented on, at both draft and final stages, by agencies, the public, the MEPA Unit, and the Secretary. The Draft EIR was published in April 1994. This FEIR/S is designed to respond to comments received on the Draft including the Secretary's certificate dated June 30, 1994 (see Appendix A), and complies with the requirements for a Final EIR as described in 301 CMR 11.07 (10).

The final component for MEPA compliance is the required review and evaluation of projects to determine whether all feasible means and measures will be used to avoid or minimize damage to the environment. This last step is a process generally referred to as a "Section 61 finding" and is required by M.G.L. c.30, § 61. No agency may act on a permit or commence a project until this finding is complete. The Draft and Final EIRs serve as the substantive bases for the Section 61 finding, and as such, the FEIR may contain a proposed finding (301 CMR 11.07(10)). This FEIR therefore, contains Massport's Draft Section 61 finding. The Department of Environmental Protection (DEP) is also required to submit its own

finding prior to issuing permits and approvals for the project.

Similarly, the Federal NEPA process is designed to insure that environmental information is available to public officials and citizens before decisions and actions are taken by Federal agencies. A federal agency's decision to prepare an Environmental Impact Statements (EIS) under NEPA based on the magnitude of the project, the similarity of the project to others which normally require an EIS, or if the nature of the project is one without precedent (40 CFR §1501.4). For this project, the U.S. Army Corps of Engineers, New England Division (Corps) is the lead federal agency for the EIS. Scoping of the EIS is based on the participation of affected federal, state and local agencies and interested persons in public scoping sessions. Scoping sessions were held in June 1992 for the Boston Harbor project.

Draft EISs are prepared in accordance with the scope derived from the scoping meetings and must meet the format requirements of 40 CFR Part 1502.10. Final EISs must also respond to comments received on the Draft. Following the review of all comments received on the Draft EIS, and the review of comments received on the Final EIS, the lead federal agency must review all relevant information and must consider all alternatives described in the EIS in order to render a decision on the proposed action. At the time of its decision, the lead agency must prepare a concise "record of decision" or ROD, identifying all alternatives considered by the agency in reaching its decision and specifying the alternative considered to be environmentally preferred. The ROD must also state whether all practicable means to avoid or minimize environmental harm have been adopted, and if not, why they were not.

This document serves to meet the requirements for a Final EIR/S as specified in 301 CMR 11.07(10) and 40 CFR Part 1503. This document identifies a preferred dredging and dredged material disposal option, assesses the anticipated environmental impacts associated with each, identifies potential long-term disposal options that may be appropriate for maintenance dredging of the completed project and responds to all comments received on the Draft.

The MEPA and NEPA processes, while different, require substantially similar environmental analysis and documentation of proposed actions. Because of this similarity in substantive material, and because regulatory agencies and the public would be simultaneously reviewing both the EIR and EIS produced for the project, Massport and the Corps elected to file a joint EIR/EIS. The combination of the two documents is specifically provided for in 40 CFR 1506.2 (c). As stated earlier, the Draft EIR/S was published in April 1994.

There are further opportunities for public review and comment on the proposed action. Under MEPA, a notice of availability of the FEIR is published in the *Environmental Monitor*. This notice is followed by a thirty day comment period, after which the Secretary of the EOEA issues a statement indicating whether or not the FEIR adequately and properly complies with the provisions of the MEPA regulations. Public comments on the FEIS may also be received and reviewed by the

Corps under NEPA and are considered in the preparation of the ROD. Readers who wish to offer comment on this document are advised to contact Ms. Nancy Baker at the MEPA office (617-727-5830) or Mr. Larry Rosenberg at the U.S. Army Corps of Engineers (617-647-8657) for the dates that the respective public comment periods close. It is anticipated that public comments will be accepted through July 31, 1995. However, individual MEPA or NEPA procedural requirements may affect this closing date.

Lastly, the proposed project will require federal, state and local permits and approvals. The MEPA and NEPA documentation will provide a substantial basis for the permit applications. The administrative procedures for acquiring the various permits and approvals also provided opportunities for agency and public comment. Permits from Massachusetts agencies cannot be issued until the MEPA process is closed by the Secretary's certificate and the preparation of a Section 61 finding by the issuing agency. Federal agencies are also barred from issuing federal permits until the NEPA process is complete and a ROD has been issued for the project. Chapter 7 of this FEIR/S describes the permits that will be required to undertake the proposed action.

Both the MEPA (301 CMR 11.07(3)) and NEPA (40 CFR § 1502.13) regulations require a purpose and need statement that briefly specifies the underlying objectives and anticipated benefits of the project. The next section provides the underlying purpose and need for the BHNIP and the economic benefits expected to accrue from its completion.

1.1 PROJECT PURPOSE AND NEED

The purpose of the Boston Harbor Navigation Improvement Project (BHNIP) is, as stated in the DEIR/S, "to increase the navigational efficiency and safety of Boston Harbor for present types of deep drafted vessel traffic..." The BHNIP will thereby enable the Port of Boston to remain competitive with other ports in the national and international marine trade business.

The existing Federal navigation project was originally constructed to serve the port's commercial terminals located along the main ship channel waterfront. Changing waterfront land use patterns have resulted in most of the port's active terminal facilities shifting from the Main Channel to the -35 foot MLW tributary channels. The BHNIP will provide for improvement dredging in the tributary channels to accommodate the current vessel fleet to a depth of -40 feet MLW.

The BHNIP as proposed is comprised of three dredging components:

1. Deepening the Mystic River and Reserved Channel areas to -40 feet MLW and deepening the Chelsea River to -38 feet MLW.

2. Deepening portions of the Inner Confluence area, as well as the Main Ship Channel at the mouth of the Reserved Channel, to provide for increased areas for navigational maneuvering.

3. Dredging associated beneficiary and related berths.

The various elements of the proposed action are described in detail in Chapter Two. The economic analysis compiled by the Corps, and contained in the 1988 Feasibility Report, concluded that the project is justified economically by increasing navigational efficiency. The BHNIP will address the Port's need to allow passage of more efficient, larger vessels which will transit the Harbor during a wider range of tidal stages. The BHNIP will enable the Port of Boston to accommodate the current fleet of container ships, with drafts up to -40 feet MLW, cruise ships, such as the QEII with a draft of -37 feet MLW, and the Chelsea-class tankers, which draw 36 feet.

Improving the tributary channel and berth depths in Boston Harbor will be the port's first major dredging project since 1982/83 when 867,000 cy of dredged material was removed from the Mystic River, Chelsea Creek and President Roads. The only additional dredging projects completed since that time have been small volume projects for maintenance of individual berths.[1]

1.1.1 Historical Importance of the Port of Boston

Boston has a long and colorful maritime history. The Port has provided jobs and economic opportunity for residents for over three hundred years. It has created fortunes in foreign trade and commerce for residents of the region. Because of a renewed interest in Boston Harbor with its commercial, recreational, scenic and commuter transportation offerings, more people are spending time there.

Today, the Port looks different from the images taken from earlier years when commercial traffic in the Harbor was heavy and terminal berths, which lined the waterfront, were always occupied by commercial vessels. Table 1.1 lists the terminals and docking facilities operating in Boston Harbor today which have been expanded to serve commercial, recreational, tourist and commuter traffic that now occupies the Harbor. Figure 1.1 depicts these docking facilities that have industrial port terminals alongside cruise ship terminals, and commuter and excursion boat docks. Boston Harbor hosts sailboat races alongside the huge container ships transiting the Harbor to reach marine terminals.

The importance of the Port to the Greater Boston metropolitan area and to the region remains vital. Over the years, it has consistently allowed the region to capitalize on its location, one day closer to Europe than other major U.S. ports.. This has been advantageous for three centuries when the bulk of trade was with North Atlantic countries. The Port now has the potential to be a U.S. gateway for trade with the rapidly growing countries in Southeast Asia, but only if its 40-foot depths are maintained.

[1] Some examples of recent dredging projects include the Mobil Oil Corp. terminal berth in the Chelsea Creek (approximately 1,500 cy) in 1991; Coastal Oil Corp. terminal berths in the Chelsea Creek and Reserved Channel (approximately 3,000 cy in 1992); and Moran Terminal in the Mystic River (approximately 10,000 cy in 1993)

1.1.2 Economic Benefits of Project

The economic benefits of the BHNIP project can be summarized as follows:

1. Increased navigational efficiency by reducing the need to wait out tides or to decrease loads prior to entering the Harbor;

2. Ability to ship more tons of containerized cargo with fewer ships;

3. Ability to attract new shipping lines;

4. Maintain navigational safety of vital refined oil products facilities.

Each of these benefits are described inthefollowing paragraphs:

1.1.2.1 Navigational Efficiency

Changes in the world wide shipping fleet have occurred in response to the need to minimize vessel operating costs and as a result of governmental regulations. While larger vessels are more costly to operate, they can move much more cargo on a given trip thereby lowering the cost per unit of cargo. In the highly competitive maritime industry, ports without ample depth cannot attract the new fleet of vessels. The cost to operate today's ocean-going vessels is too high to support unproductive time waiting for tide changes or traveling at less than full loads. As an example, Massport notes that it can cost $35,000 per day to operate a container ship. The 40-foot depth of Boston's main navigation channels and the proposed depth of -40 feet MLW in two of its tributaries, and -38 feet in Chelsea Creek will enable these large ships to move through the Harbor.

Alternately, if there is no dredging project and shipping lines still must wait for the high tide, the Port is likely to see a reduction in direct calls. This could discourage shippers who object to the added cost and extra time required for lightering to barges or overland movements. These shippers will seek out more direct shipping opportunities. Equally important is that without improvement dredging, there could be a reduction in cargo volume moving through the Port which translates into economic loss to the region.

1.1.2.2 Containerized Cargo Volumes

The number of deep-drafted vessels calling in the Port of Boston may have diminished over the years, as shown on Table 1.2, but larger vessels can now carry a greater volume of cargo. In 1975, for example, 272 fully containerized vessels called with some 400,000 tons of cargo. In 1994, 198 vessels called with over 1,313,000 tons of cargo (see Table 1-3 which identifies deep draft vessels by type of vessel, and Figure 1-2, which shows the volume of containerized cargo coming through the Port).

The magnitude of potential gains and losses depending on a decision about dredging is shown on Table 1-4. The table assumes that the dredging project is completed in 1998 and that cargo tonnage increases at the rate of 3% for a total of 1,514,200 tons in that year. That tonnage

yields about $1.73 billion in value including 13,000 total jobs in the region.[2]

Using what Massport considers to be a conservative growth rate, 3% annually, for the volume of cargo coming through the Port, the table shows that the total new cargo volume will be over 241,000 tons at the end of five years.[3] The economic benefit of the additional tonnage will be over $277 million (not discounted to 1995 dollars). This represents almost 1,900 new jobs. The BHNIP enables this growth to occur by ensuring that vessels can transit the Harbor with a minimum of delay.

1.1.2.3 Ability to Attract New Shipping Lines

On the other hand, news of a No-Action decision on dredging Boston Harbor will affect the decisions of shipping lines and shippers, since navigational delays and restrictions will continue, and will likely decrease the volume of cargo coming through the port. Once the decline in tonnage begins, it will be difficult to turn around. The fixed costs to operate the port for diminishing cargo volumes could eventually prove too high to operate cost-effectively.

Without dredging, the Port of Boston potentially loses the direct calls, with the accompanying loss of tonnage moved through the port. Table 1-4 shows that with annual declines of 1%, 3%, or 5% in cargo tonnage, losses in benefits to the region over a five year period, range from $85 million to $392 million. Job losses in the port community could be anywhere from about 580 to 2,700 during that time. This is for containerized cargo, alone. Cruise ships, currently drawing 25-37 feet, also need convenient access to berths to sustain this industry which has brought additional tourism to the region.[4]

1.1.2.4 Maintain Refined Oil Product Capacity

The BHNIP is especially important to the region because it keeps the Port of Boston open to supply the region's growing energy needs. Without refineries of its own, New England's refined oil products must be brought in from the Mid-Atlantic states or the Southwest, or imported from abroad. Most of the product arrives through ports, and the Port of Boston is a dominant player in this arena.[5] Vessels carrying petroleum products are also getting larger to minimize operating costs per gallon. The size of vessels also is increasing in response to the mandate for double-hulled tankers pursuant to the Oil Pollution Act of 1990. New tankers may have the same carrying capacity as the old ones, but will draw more because of the double-hull and will be wider.

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[2] Massport calculates economic impact to the region of each ton of cargo is $1,120.

[3] Massport internal memorandum, "*Marketing Projections of Container Volumes and Vessel Calls*, January 13, 1995.

[4] Massport data indicates that 23 cruise ships called in 1993, 49 called in 1994.

[5] Massachusetts Division of Energy Resources Report, March 1992.

When the "Chelsea-class" vessels, which currently operate in the port and draw 36 feet, retire, the new vessels coming on line to replace them will be larger and will require more depth since Chelsea-class vessels are no longer financially viable to operate. The newer vessels will be restricted by two factors:

1. Tides - Insufficient depth at mean low water requires vessels to partially unload or "lighter" the vessels prior to entering the Harbor. The lightering process entails pumping product from the vessel to a barge. It is inefficient because it requires the double-handling of product.

2. Day light hours - The wait for high tide can be especially costly for vessels bound for Chelsea Creek since the Coast Guard prohibits vessels measuring more than 630.5' in length and 85.5' in beam from transiting the "marine safety zone" in Chelsea Creek between sunset and sunrise. Maintaining a schedule for accessing berths in Chelsea Creek can be difficult, especially in winter, given the need to have both high tide and daylight, and given the few hours of daylight in winter.

Each fuel company has its own method for calculating the cost to "lighter". While the transfer of product may cost 0.5 cents per gallon, that figure does not include the cost of delay to a vessel during the lightering operation. The cost of the delay depends on the amount of product requiring transfer. While there is no definitive figure for the cost of lightering in the Port of Boston, recent analyses have suggested 4-4.5 cents per gallon as a cost attributable to lightering in the Ports of Providence and New Haven. This cost is generally passed on to the customer. Given the inconvenience currently posed by lightering and delays for high tide, the BHNIP will in general, facilitate movement of cargoes through the Port, minimizing the frequency of those procedures and increase the margin of safety for those vessels currently operating in the Port.

1.2 PROCEDURAL HISTORY

The publication of this FEIR/S is the culmination of many years of analysis and review. Since the publication of the Draft EIR/S in April 1994, the project proponent and the Corps have had close coordination with state and federal agencies on all aspects of the Project. The following pages outline the procedural history and development of this document and the coordination efforts of the project partners.

1.2.1 Congressional Authorization

The genesis of the Boston Harbor dredging project can be traced back to 1968 when Congressional and local interests expressed the need for modifications to Boston Harbor channels because of the increased traffic in bulk commodities flowing through the port, and the delays being experienced by larger vessels requiring a high tide to negotiate the existing restricted ship channels into areas of the port. Local navigation interests, via two Congressional Resolutions (March 1, 1968 and September 11, 1969), requested the Corps review the present and projected navigation needs in

Boston Harbor. The Corps maintains the authority to conduct General Investigations into improving the navigability of waters of the United States under the River and Harbors Act of 1899.

A Feasibility Report and Environmental Assessment was completed in 1988 by the U.S. Army Corps of Engineers for the navigation improvement project, identifying the economically and environmentally favored alternative. Congressional authority for the project was included in the Water Resources Development Act of 1990 (P.L. 101-640). The favored alternative consisted of deepening the Mystic River and Reserved Channel from -35 feet to -40 feet MLW, and the Chelsea Creek from -35 feet to -38 feet MLW. The 1988 favored alternative also included dredged material disposal at the MBDS, with capping of unsuitable material. In addition to the proposed deepening, the favored alternative called for modifications in the Mystic River, the Inner Confluence and at the entrance to Reserved Channel to provide safe maneuvering areas. Finally, in the President Roads area, channels are to be remarked and designated along the southern reach of the roads connecting the outer confluence of the three entrance channels with the inner harbor Main Ship Channel. This will enlarge the anchorage area from about 375 acres to about 420 acres. This portion of the Congressionally authorized proposed action is termed the "improvement" project.

Six berth areas adjacent to these channels (Conley 11-13, Prolerized, Distrigas, Moran, Eastern Minerals and Gulf Oil), deepened to at least the same depth as the channel, would realize the greatest economic benefits from the "improvement" project. Deepening these berths is termed the "berth dredging" project and these selected berths are collectively termed "beneficiary" berths. The 1988 Corps feasibility study assessed the economic feasibility of the proposed "improvement" and "berth dredging" projects and found that the regional benefits of the project exceeded project costs.

In addition to the beneficiary berths, other berths within Boston Harbor, but not adjacent to the Federal project channels being improved (Boston Army, Boston Edison Intake, Boston Edison Barge, Conley 14-15, Revere Sugar, Mystic Piers 1,2, 49 and 50), would also be deepened at the same time as part of Massport's Berth Dredging Project. Both the Corps improvement and berth dredging projects, and Massport's berth dredging projects, are collectively termed the Boston Harbor Navigation Improvement Project (BHNIP). There are two main differences between the Congressionally authorized proposal and the BHNIP. First, under the BHNIP dredged silts will not be disposed of at the MBDS, unlike the 1988 proposal. It is now proposed that silts be disposed within the dredging footprint of the authorized channels in trenches excavated for that purpose. Although this will entail digging portions of these channels deeper than authorized for the navigation project, this is permissible because the extra depth is for disposal, not navigation.

Second, the non-beneficiary berths (those not adjacent to the federal improved channels) were not included in the 1988 proposal but are considered part of the BHNIP. The term BHNIP will be applied to all aspects of the Corps and Massport projects and will be treated as one throughout this document except where otherwise noted. The locations of

proposed dredging activities are shown on Figures 1-3 through 1-9.

1.2.2 Public and Agency Review

As stated earlier, the BHNIP is subject to review under the Massachusetts Environmental Policy Act (MEPA) (M.G.L. c. 30 § 62A-H and regulations promulgated thereunder at 301 CMR 11.00). The Secretary of Environmental Affairs determined on June 7, 1991, that an Environmental Impact Report (EIR) is required since the Massport berth dredging project involves the dredging and alteration of ten or more acres of resource area protected by the wetlands regulations (310 CMR 10.00). In June 1992, the U.S. Army Corps of Engineers determined that an EIS is required for the federal project under the National Environmental Policy Act (NEPA) (42 USC 4321 *et. seq.*) due to the cumulative impacts of the Federal actions (maintenance dredging, navigation improvement dredging, and permitting of the associated berthing areas) and the significant public concern over disposal of the dredged material. The content of the EIR/S was prescribed in the June 1991 MEPA certificate and June 1992 NEPA scoping documentation which appear in Appendix A of the Draft EIR/S published in April 1994.

After publication of the Draft EIR/S in April 1994, the public review process of the DEIR/S included several public meetings, meetings with concerned interest groups, and the receipt of the sixty-one comment letters from federal, state, and local agencies, commercial interests, private interest groups and private citizens. Public meetings were held in Boston and Hyannis on May 17 and 19, 1994 respectively. These meetings were planned under the direction and guidance of the New England Division (NED) Corps and consisted of a variety of techniques tailored to the individual project including a public partnership between the NED-Corps, Massport and public advocacy groups such as the Conservation Law Foundation and Save the Harbor/Save the Bay.

The meetings were designed to offer multiple opportunities for public input in identifying issues early in the process so they could be fully addressed through additional data collection and analysis and publication in the FEIR/S. Afternoon and evening sessions were held at both locations to allow for maximum opportunity for interested public comment. The Boston sessions resulted in formal comments from sixteen individuals and public interest groups. The Hyannis meetings generated formal comments from seven individuals and groups. Transcripts of both meetings are provided in Appendix B. On July 28, 1994, a special meeting was held in Nahant in response to a request from the Board of Selectmen. Thirty one speakers offered comments for the record. A copy of the transcript from this meeting is also included in Appendix B.

At the request of specific individuals and groups, presentations were made at various locations with stakeholders and groups, and one-on-one presentations and interviews.

These meetings were in addition to the public participation process described in Section 1.4 of the DEIR/S.

1.2.3 Public Participation Process

The Corps and Massport recognize that large projects which may impact the public cannot be accomplished unilaterally. Rather, the success of the project depends on involving key groups effectively. This general principle had a number of important implications. Key parties needed to be identified which either had a stake in the outcome (regulatory agencies, environmental groups, and harbor users), or could provide useful information to the Corps, Massport, and its consultants. Effective involvement of these parties required that they be consulted early, that they be provided timely information on the progress of the project, and they have the opportunity to present diverse points of view. To that end, the Corps, Massport and its consultant developed a public participation process which consisted of a broad-based Advisory Committee supplemented by targeted, focused working groups to assist project planners in particular technical areas such as sediment characterization and disposal alternatives. A list of Advisory Committee and Working Group members is provided in Appendix C.

The Advisory Committee convened twice during the preparation of the FEIR/S, in September 1994 and March 1995. The Advisory Committee was instrumental in assisting the project team in identifying major areas of concern regarding the DEIR/S that required additional data collection or analysis in the FEIR/S. The meetings also identified the need for two supplemental working groups. These consisted of a working group meeting in November 1994 focusing on developing a comprehensive data base of dredged material treatment and disposal technologies. The results of the technology screening process are described in Chapter 3.0 of this FEIR/S. A second working group convened in December 1994, focusing on mitigation and monitoring concerns that would be developed into a comprehensive Dredge Management Plan, as required by the Secretary's MEPA certificate (see Appendix A).

1.2.4 Inter-Agency Coordination

In addition to the public participation process, the project team also engaged in several meetings with combined EOEA agencies since the late summer of 1994. These meetings assisted the project team in clarifying technical comments the agencies provided in letters responding to the DEIR/S; assisting the project team in designing data collection studies; coordinating EOEA agency responsibilities; and focusing on related pre-permitting activities. These meetings have been invaluable to the development of this FEIR/S.

Meetings were also held between the Federal cooperating agencies and the NED-Corps to address Federal issues concerning comments on the Draft EIR/S and the permitting process under the Clean Water Act and the Marine Protection, Research, and Sanctuaries Act. Formal meetings were held with the Federal agencies in November 1994 and March 1995, as well as informal meetings, to narrow the list of practicable disposal sites based on functions and values, under a process known as the Federal Highway Methodology, as well as cost and engineering feasibility.

The extensive comment and input process described above has assisted the project

team in identifying and assessing project alternatives and their impacts. Volume 2 of this FEIR/S contains detailed comment responses for each letter received or comment made at the public meetings. The next section highlights the most significant changes made to the project in response to the public and agency review process. Each of these issues, and many others, are fully developed in the later pages of this document.

1.3 SUMMARY OF MAJOR CHANGES FROM THE DEIR/S

This section highlights significant findings and issues that were raised as concerns during the DEIR/S review process and how they have been resolved in the FEIR/S.

1.3.1 Use of Massachusetts Bay Disposal Site (MBDS)

A great deal of public comment on the DEIR/S centered on the use of the MBDS as a potential disposal site for contaminated sediments. The comments can be grouped into three major areas as follows:

- The expressed concern that the site is not suitable for the disposal of contaminated materials until capping is proven effective in eliminating transfer or bioaccumulation of contaminants into the environment in a demonstration project as required by 40 CFR 228.12, as amended.

- A perception that the Corps has not demonstrated that they can successfully cap at MBDS depths, based on the current body of engineering studies available from the Corps.

- The expressed concern that contaminated material loss during the drop of dredged silts into deep water may be more significant than that projected in the DEIR/S, with resulting potential deleterious effects on aquatic life near the site and at Stellwagen Bank.

In response to these concerns, the project proponent and the Corps have eliminated the MBDS as a viable disposal option for contaminated silt for the BHNIP project. The MBDS will be used for disposal of uncontaminated parent material and is being considered for disposal of future maintenance dredging material provided the Corps or other agencies effectively complete demonstration projects for capping or other technology as described in Section 2.4 of this document.

1.3.2 Use of Cost as a Ranking Factor in Evaluating Disposal Alternatives

In screening and ranking the desirability of various disposal options, the DEIR/S used disposal of contaminated silts at MBDS as a baseline cost against which other disposal options were measured. Since MBDS is not a viable option for the disposal of contaminated silts, for this phase of the project, this cost baseline no longer holds for disposal of that material. While costs are still used as a ranking factor in this FEIR/S it is no longer the primary consideration, nor are options rejected solely on this basis. **We have eliminated (in response to comments) any across-the-board cost cap in screening sites and**

disposal options. This has been substituted with a two-step approach that: 1) evaluates sites and options in terms of environmental acceptability; and 2) ranks the most environmentally acceptable alternatives based on cost-effectiveness. Under this approach, no environmentally acceptable option is discarded without receiving a review on its merits.

1.3.3 Emphasis on Using Previously Impacted Areas

Many comments from the public made clear that they preferred confining the impacts of dredged silt disposal to already-impacted areas in the Inner Harbor, rather than realizing impacts in the relatively pristine Outer Harbor or Massachusetts Bay. The concerns centered on the following issues:

- Fisheries habitat disruption, especially prime valuable lobster habitat at the Meisburger sites.
- Overlap of the MWRA outfall impacts with use of Meisburger 2 could make tracing contamination sources difficult.
- Boston Harbor sediments should not be "exported" to Massachusetts Bay, but kept confined on land or in the Inner Harbor.
- The increasing pressure on the fishing industry as a result of dwindling stocks will be exacerbated by the use of the open water aquatic sites.

To address these concerns, the project proponent and the Corps undertook a detailed fish, lobster and benthic survey of all potential aquatic sites to evaluate and compare their relative resource value. The sampling program and results are fully described in Chapter Four. Based on this analysis, and in part on public concerns, **the project proponent and the Corps have eliminated the use of sites in the Outer Harbor and Massachusetts Bay from further consideration for the disposal of the BHNIP silt.** Future studies, including capping and geotextile technology review, will be undertaken to evaluate the potential use of these sites for future maintenance material.

1.3.4 Sediment Characterization

The DEIR/S indicated that the Corps determined that approximately 360,000 cubic yards (cy) of silt was suitable for ocean disposal based on bulk chemistry, bioassay and bioaccumulation data required by ocean dumping regulations in 40 CFR Chapter 1, Subpart B. However, using the same data, the U.S. Environmental Protection Agency (EPA) determined that none of the silt was suitable for unconfined ocean disposal. In response to these comments, the Corps adopted the more conservative position and assumed that **all silt from the Corps improvement and beneficiary dredging, and the Massport berth dredging, is considered unsuitable for unconfined ocean disposal.** Therefore, disposal options were developed for the entire in-situ silt volume of 1.1 million cy. Parent material, consisting of uncontaminated clay and sand, from the deepening and improvement of the Federal channels, was determined to be suitable for disposal at the MBDS. Potential options for the beneficial re-use of the clay material are discussed in Chapter 3. Rock to be removed from the channels will be used to armor disposal sites from ship and storm-generated waves

or other beneficial uses. Rock remaining after these applications will be disposed at the MBDS.

1.3.5 Treatment Technologies

The public review process generated great interest in identifying and considering new technologies for handling and treating contaminated marine silts. A number of commentors suggested that the project proponent and the Corps look more carefully at these technologies. The technology that generated the most interest was the potential use of geotextile containers. As described in Section 2.4, the Corps is monitoring on-going projects in other Corps districts around the country, and at the Corps' Waterway Experiment Station (experimenting with geotextile containers). This technology is a containment technology rather than a chemical or biological treatment of sediments per se. The project proponent and the Corps also polled thirty-seven technology providers using a detailed questionnaire developed with the assistance of the Disposal Options Working Group.

The technologies screened through the questionnaire process are considered not currently practicable due to a lack of demonstrable success, logistics of deployment, "permittability" questions, cost, management of by-products, and the ability of the technologies to handle the volumes and types of contaminated silts generated by the Project. The technology survey is more fully described in succeeding sections of this FEIR/S. The survey form and results are presented in Appendix D. The Corps will continue to work with other Corps districts to monitor the development of treatment and containment technologies, especially geotextile containers, as they may become available and suitable for future maintenance dredging purposes.

1.3.6 Site Screening and Development of Disposal Options

As described in the DEIR/S, the site screening process was developed in coordination with the Advisory Group and a specific Disposal Options Working Group. Several commentors raised concerns as to how the screening criteria were applied, especially concerning minimum site capacity requirements and the use of a baseline cost comparison. As stated in Section 1.3.3, cost information continues to be one factor in the practicability determination, but will no longer be used as the primary screening criterion. In addition, limited site capacity is not viewed as a fatal flaw in site selection, but is considered with other factors such as environmental impacts associated with a site, developability of the site, constructability and access concerns, permittability, neighborhood impacts, and costs of development for unit of storage. **Individual sites were not screened out based solely on their limited capacity or higher total cost if, in combination with other sites, they might comprise least environmentally damaging practicable alternatives (LEDPA).** Cost, capacity and other practicability considerations were applied only after the environmental analyses were completed.

1.3.7 Detailed Dredge Management Plan

Several commentors requested more specific information on dredging and disposal performance standards to ensure compliance with permit conditions and

compliance with permit conditions and general environmental quality standards. As an example, the project team has responded to these concerns by specifying the use of an environmental bucket to minimize release of contaminated sediment during dredging and outfitting the bucket with a sensor to detect whether it is in a closed condition or if closing is impeded by debris.

The Dredge Management Plan (DMP) also contains:

- specific recommendations for dredging equipment;
- detailed descriptions of the dredging and material disposal operations;
- the scheduling and timing of dredging and disposal operations;
- an overview of potential environmental impacts caused by dredging and disposal and proposed techniques for mitigating these impacts;
- environmentally-based dredging performance standards;
- a description of recommended monitoring plans during dredging and for long-term, post-construction monitoring;
- a discussion of operational contingency plans that would be implemented to assure the safe and successful completion of the project.

1.3.8 Summary of Changes

The issues addressed in the preceding paragraphs have resulted in the following project changes:

- Based on applicable environmental screening criteria, all silts generated by the project are considered unsuitable for unconfined ocean disposal.
- The MBDS, Subaqueous B and E, Meisburger 2 and 7, Boston Light Ship, and Spectacle Island CAD have been eliminated from further consideration as practicable disposal sites for BHNIP silt. These sites are still being considered as potential disposal locations for future maintenance dredging. Use of these disposal sites for future maintenance dredging may require additional studies, demonstration projects, or the application of appropriate technologies that may render these sites practicable in the future.
- All parent material, consisting of sand and clay, generated by the project is considered suitable for disposal at MBDS or for beneficial re-use, including as a potential source of capping material for unlined municipal landfills.
- Technologies will continue to be assessed by the Corps for their potential applicability to future maintenance dredged material.
- Cost considerations and capacity are no longer considered to be fatal flaws in disposal site screening. Cost is factored in only to assess

the relative cost-effectiveness of disposal scenarios determined to be environmentally suitable and to determine practicability. Capacity is only one factor considered in site screening and combinations of sites of limited capacity may constitute acceptable disposal scenarios.

1.4 FORMAT OF THE FEIR/S

The foregoing sections highlight significant issues arising from the careful consideration this project has received by Federal, state and local agencies; commercial interests; public interest groups; and private citizens. The project proponent and the Corps are grateful for the time and effort expended by so many in assisting in the development of an environmentally acceptable and fiscally responsible project. A list of preparers is provided in Table 1-5. The remainder of this section describes the format of this document to assist the reader in locating critical text.

Due to the complexity of the project, and the extent of the public review process, this FEIR/S is designed to serve, as much as possible, as a stand-alone document. This FEIR/S incorporates by reference in its entirety the Draft EIR/S and all referenced technical reports and studies. Specific references will be made to portions of the DEIR/S as appropriate to avoid duplication of massive technical appendices. Critical issues developed in the DEIR/S will be extracted and distilled in the FEIR/S so that the general reader will understand the issues presented.

As a result of our effort to make this FEIR/S readable, and as a result of numerous comment letters, this FEIR/S consists of three volumes. Volume I contains the main text material; Volume 2 consists of a photocopy of comment letters received since the publication of the DEIR/S and an individual response to each letter. Volume 3 contains all referenced appendices.

A summary of the contents of Volume 1 are as follows:

- Chapter Two (Project Description) presents the dredging project, its limits and components, and the alternatives considered in designing the channel and berth dredging. This section provides the final calculations of parent material to be dredged for the maintenance and improvement projects as well as material excavated for the preferred disposal options. It also describes future maintenance dredging requirements after project completion over the 50-year design life of the project.

- Chapter Three (Material Disposal Site Selection Process) presents the dredged material disposal option selection process. Of special note is the discussion of additional data collection efforts conducted in response to comments received during the public review process. These efforts included a fishery, benthic and lobster study and short and long-term modeling to determine water quality impacts.

- Chapter Four (Selection of Preferred Disposal Option) is the heart of the environmental analysis portion of this FEIR/S. It presents a detailed explanation of the

environmental benefits and detriments of a number of disposal scenarios. The discussion is developed against the framework of Massachusetts Wetlands Protection Act and water quality standards, federal functions and values assessments under the Clean Water Act, and a comparison of all least environmentally damaging alternatives. Finally, practicability concerns are layered onto the evaluation to consider cost, availability, and logistics to eventually arrive at a single preferred disposal scenario. Chapter Four culminates with a detailed description and evaluation of the preferred disposal option. The preferred option consists of in-channel disposal, with capping.

- Chapter Five (Dredge Management Plan) is the technical core of this document. It presents the detailed Dredge Management Plan (DMP) that was prepared in outline form in the DEIR/S. The DMP provides a detailed sequence of construction for both the dredging and disposal operations. The plan also addresses concerns raised in the comment letters regarding construction and post-construction monitoring and contingency planning for reasonable and foreseeable environmental or operational occurrences.

- Mitigation concepts, both resource and operationally-oriented, are described in Chapter Six (Mitigation Planning and Proposals). Mitigation concepts are presented in sufficient detail to enable the reader to understand the range of mitigation considered by the project proponent and the Corps as well as the issues which are likely to be addressed during the permitting process.

- The permitting and regulatory requirements which the project must meet are defined and described in Chapter Seven (Regulatory Compliance).

- Chapter Eight (Section 61 Finding) provides a draft Section 61 finding to meet Massport and EOEA agency obligations under 301 CMR 11.00.

- Chapter Nine (Literature Cited) provides detailed references for the technical reports cited in the text.

- Chapter Ten (Glossary of Terms) provides definitions for the technical terms used in this report.

■ Massport Properties

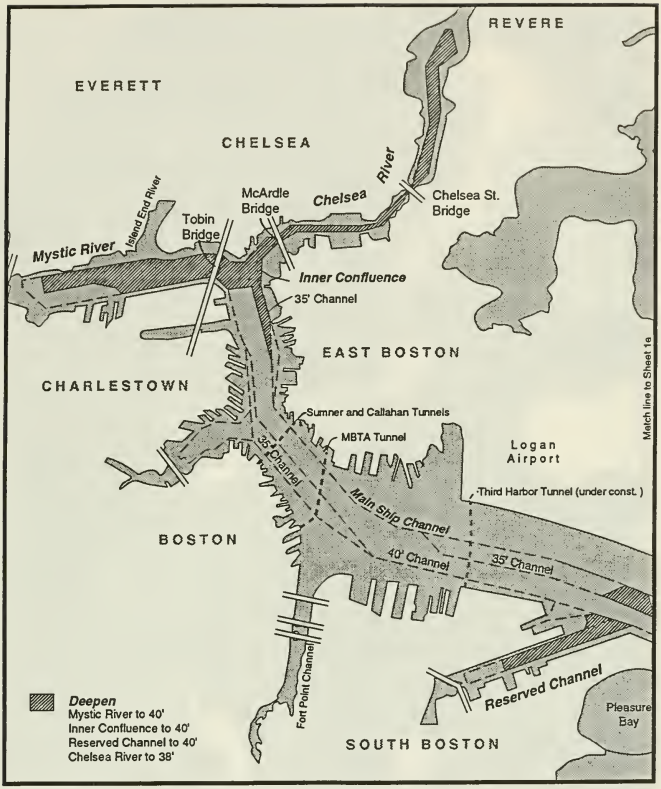
1. Fort Independence
2. Conley Terminal
3. Coastal Oil South Boston
4. MBTA Power Plant
5. Boston Edison Power Plant
6. The Black Falcon Cruise Terminal
7. The Harbor Gateway
8. Coastal Cement Term.
9. Boston Marine Industrial Park, South Jetty, Drydock 3
10. Massport Marine Terminal, North Jetty
11. General Ship Corp.
12. Boston Fish Pier
13. World Trade Center
14. Federal Courthouse site
15. Museum Wharf
16. Boston Tea Party Ship Museum
17. Rowes Wharf/Boston Harbor Hotel
18. India Wharf
19. Central Wharf
20. Long Wharf/Marriott
21. Commercial Wharf
22. Lewis Wharf
23. Lincoln Wharf
24. Battery (Constitution) Wharf
25. US Coast Guard Support Center
26. Paul Revere Park
27. Constitution Plaza and Constitution Marina
28. USS Constitution and National Park
29. Charlestown Navy Yard
30. Mystic Pier #1

● Non-Massport Properties

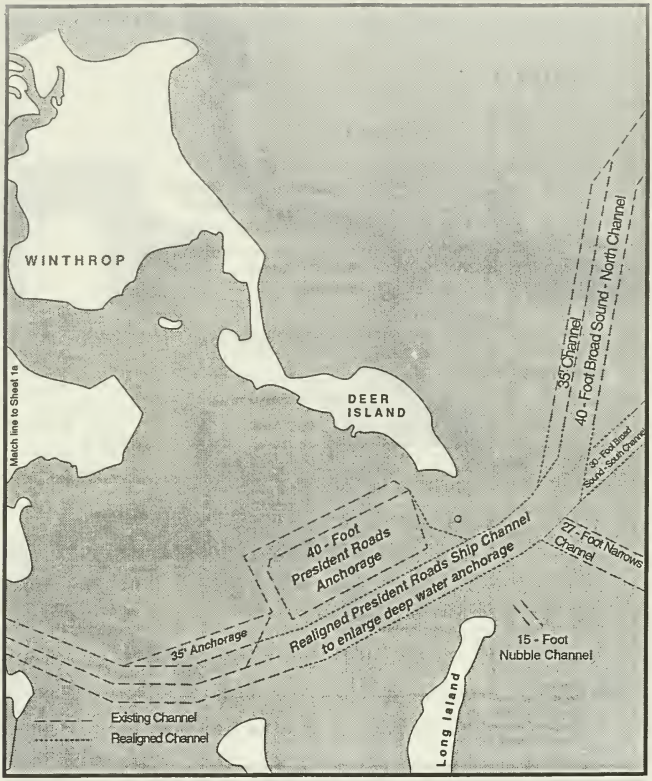
31. Mystic Pier 48 Salt Terminal
32. US Gypsum
33. Moran Container Term.
34. Blue Circle Atlantic
35. Medford Street Term.
36. Charlestown Marine Park
37. Boston Edison
38. Prolerized Scrap Terminal
39. Distrigas Liquified Natural Gas Terminal
40. Exxon Oil Term.
41. Independent Cement Corporation
42. Coldwater Seafood Terminal
43. Admiral's Hill Condominium/Marina
44. Atlantic Fuel Terminal
45. Eastern Minerals Salt Terminal
46. Coastal Oil New England, Inc.
47. Walton Pier
48. Gulf Oil Terminal
49. Coastal Oil Terminal
50. Northeast Petroleum Terminal
51. BP Oil Term.
52. Global Petroleum Terminal
53. Mobil Oil Terminal
54. Boston Towing & Transportation Company, Inc./North Terminal
55. General Ship and Engine Works
56. East Boston Piers
57. Boston Marine Works
58. Logan International Airport
59. Logan Office Center

Figure 1-1

PORT OF BOSTON CONTAINER ACTIVITY
CALENDER YEARS 1975 THROUGH 1994
FIGURE 1-2
SHORT TONS
(MILLIONS)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94
YEARS
IMPORT SHORT TONS
EXPORT SHORT TONS



Boston Harbor Dredging Project EIR/S	Figure 1-3 Boston Harbor Navigation Improvement Project General Plan
N *Scale:* 0 2000' 4000' Scale in Feet	*Source:* New England Division, Corps of Engineers

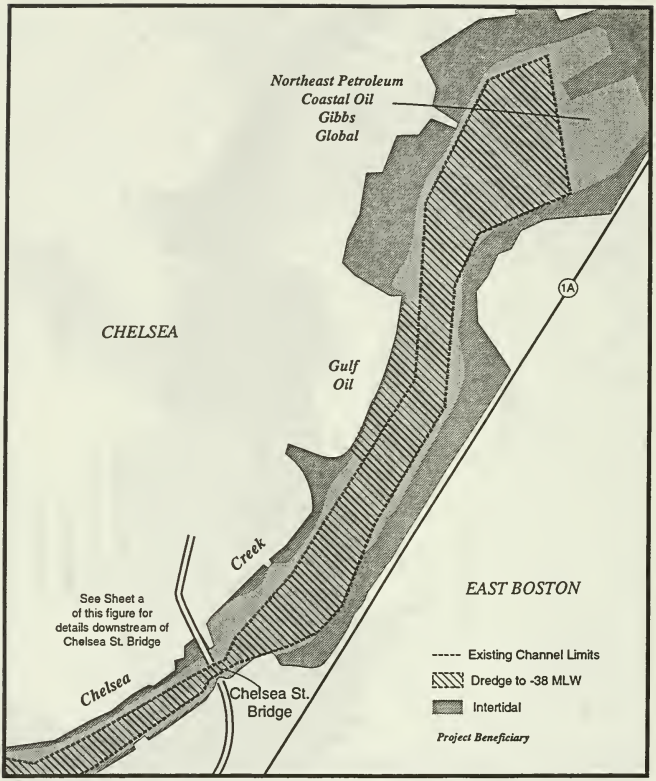

WINTHROP
DEER ISLAND
Match line to Sheet 1a
35' Channel
40 - Foot Broad Sound - North Channel
35' Foot Broad Sound - South Channel
40 - Foot President Roads Anchorage
Realigned President Roads Ship Channel to enlarge deep water anchorage
27 - Foot Narrows Channel
35' Anchorage
15 - Foot Nubble Channel
Long Island
Existing Channel
Realigned Channel

Boston Harbor Dredging Project EIR/S	Figure 1-4 Boston Harbor Navigation Improvement Project General Plan
N *Scale:* 0 2000' 4000' Scale in Feet	*Source:* New England Division, Corps of Engineers

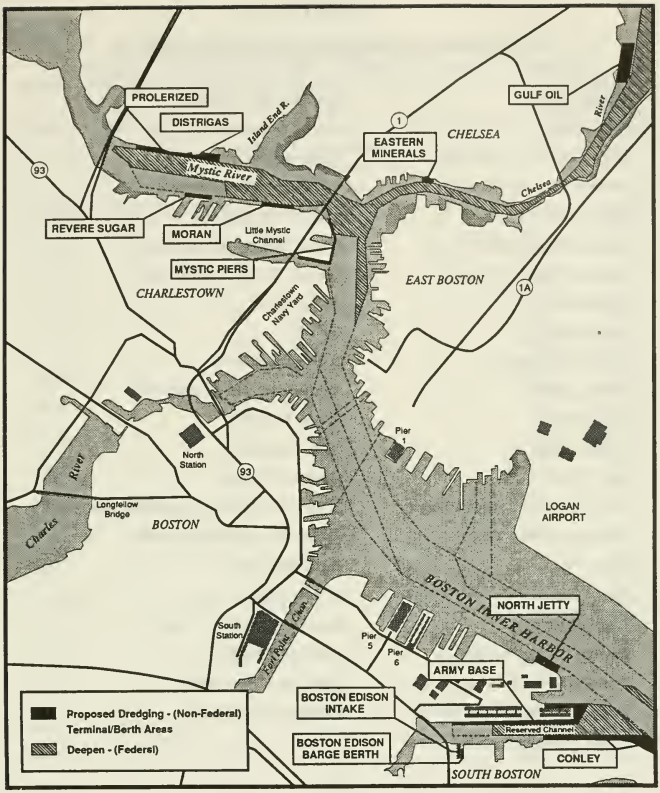
Boston Harbor Dredging Project EIS/R	Figure 1-5 Navigation Improvement Project **Reserved Channel**
N *Scale:* Scale in Yards	*Source:* Boston Inner Harbor Navigation Chart

Boston Harbor Dredging Project EIR/S	Figure 1-6 Navigation Improvement Project Mystic River
N Scale: 0 400 800 Scale in Yards	Source: Boston Inner Harbor Navigation Chart

Boston Harbor Dredging Project EIR/S	Figure 1 - 7 Navigation Improvement Project Chelsea Creek Downstream of Chelsea St. Bridge
N Scale: Scale in Yards	Source: Boston Inner Harbor Navigation Chart



Boston Harbor Dredging Project EIR/S	**Figure 1 - 8** Navigation Improvement Project **Chelsea Creek** **Upstream of Chelsea St. Bridge**
N *Scale:* *Scale in Yards*	*Source:* *Boston Inner Harbor Navigation Chart*



Boston Harbor Dredging Project EIR/S	Figure 1-9 Location of Federal Channel and berth area dredging
N *Scale:* 0 400 800 Scale in Yards	*Source:* Boston Inner Harbor Navigation Chart

TABLE 1-1.

TERMINALS AND DOCKING FACILITIES

Conley Terminal	Distrigas LNG Terminal*
Coastal Oil*	Exxon Oil Terminal*
Black Falcon Cruise Terminal	Independent Cement Corp.
South Boston Army Base	Coldwater Seafood Terminal
Coastal Cement	Atlantic Fuel Terminal
Boston Marine Industrial Park	Eastern Minerals Salt Terminal*
Massport Marine Terminal	Coastal Oil New England, Inc.*
General Ship	Walton Pier
Boston Fish Pier	Gulf Oil*
World Trade Center	Coastal Oil Revere*
McKie Lighter	Northeast Petroleum Terminal*
Rowes Wharf	BP Oil Terminal
Central Wharf	Global Petroleum
Long Wharf	Mobil Oil Terminal
U.S. Coast Guard Support Center	Boston Towing and Transportation Co., Inc.
Charlestown Navy Yard	General Ship and Engine Works
Mystic Pier 1	East Boston Piers
Mystic Pier 48	Boston Marine Works
U.S. Gypsum	Logan Airport Water Shuttle
Moran Container Terminal	Deer Island-MWRA
Blue Circle Atlantic Cement, Inc.	Lewis Street-East Boston
Massport-Medford Street Terminal	Prolerized Scrap Metal*
Boston Edison*	

* Berths receiving direct economic benefits from BHNIP

TABLE 1-2.

VESSEL ACTIVITY IN THE PORT OF BOSTON: ARRIVALS WITH DRAFTS GREATER THAN 18 FEET*

Year	Dry Bulk Carriers	General Cargo	Fully Containerized General Cargo	Passenger	Tankers/ LNG	TOTAL
1972	225	480	163	36	635	1539
1973	235	401	244	53	665	1598
1974	132	196	276	24	633	1261
1975	129	140	272	19	571	1139
1976	120	160	279	9	583	1151
1977	126	137	262	8	628	1161
1978	134	141	265	8	542	1140
1979	118	117	284	14	548	1081
1980	118	134	289	25	440	1006
1981	106	119	291	28	427	971
1982	92	107	277	21	337	834
1985	77	91	200	14	323	705
1986	82	85	215	19	374	775
1987	81	89	248	23	315	756
1988	89	81	237	18	308	733
1989	72	74	202	13	300	661
1990	59	89	210	15	318	691
1991	39	75	168	39	296	617
1992	41	88	154	33	294	610
1993	39	78	173	20	280	590
1994	52	77	198	48	308	683

* As handled by Boston Pilots.

Source: Massport and Boston Shipping Association

TABLE 1-3.

TRIPS AND DRAFTS OF VESSELS USING BOSTON HARBOR 1960-1993

	Number of Trips					
Year	Draft 41-45 ft.	Draft 36-40 ft.	Draft 31-35 ft.	Draft 25-30 ft.	Draft 20-25 ft.	Total Trips for Year
1960	—	24	438	669	2,135	3,266
1965	3	53	440	500	2,074	3,067
1970	1	214	477	483	1,622	2,799
1975	3	195	368	598	1,051	2,213
1976	—	218	396	649	1,028	2,294
1977	—	226	427	667	826	2,146
1978	—	206	371	590	704	1,871
1979	—	219	370	675	743	2,007
1980	—	127	311	638	667	1,743
1981	—	122	314	705	669	1,810
1982	—	76	292	677	711	1,756
1983	—	77	264	539	710	1,590
1984	—	131	210	455	852	1,648
1985	—	113	209	453	848	1,623
1986	—	133	170	123	398	824
1987	—	122	199	285	351	957
1988	—	154	156	308	270	988
1990	1	174	291	387	689	1,542
1991	1	133	304	371	566	1,375
1992	1	131	326	352	576	1,386
1993	1	144	405	295	627	1,472

This tables was initially prepared as part of the Boston Harbor Marine Traffic Report by the Maguire Group, April 1988, for the Massachusetts Water Resources Authority and included data for 1960-1985. The 1986-1988 informatioo was obtained from the U.S. Army Corps of Engineers.

Source of 1960-1988 numbers: Waterborne Commerce Statistics, U.S. Army Corps of Engineers

Source of 1990-1993 numbers: Impact Analysis Division, U.S. Army Corps of Engineers

TABLE I-4.

CARGO VOLUME AND IMPACT ON ECONOMIC BENEFIT TO THE PORT OF BOSTON

Economic Benefit to the Port of Conservative 3% Annual Rate of Growth

Year	1998	1999	2000	2001	2002	2003	Total
Cargo tons	1,514,200	1,559,626	1,606,415	1,654,607	1,704,245	1,766,373	9,905,466
Net Change in Tons	0	45,426	46,789	48,192	49,638	51,127	241,172
Economic Benefit ($1,000's)[1]	0	52,014	53,674	56,181	55,637	58,642	$277,348

Economic Impact Assuming Annual Decline in Cargo Volume[2]

Percent Decline in $1,000 Benefit

Year	1998	1999	2000	2001	2002	2003	Total
1%	0	17,338	17,164	16,993	16,823	16,655	84,773
3%	0	52,014	50,453	48,940	47,471	46,047	244,925
5%	0	86,689	82,355	78,237	74,325	70,609	$392,215

[1] Each cargo ton adds over $1,100 in value

[2] To determine number of jobs/ton of cargo multiply tonnage x .0078. Therefore, the loss of 74,211 tons of cargo, representing an annual 1% loss over five years, results in the loss of 579 jobs. The loss of 642,541 tons of cargo, representing an annual 5% reduction, represents 2,672 jobs.

TABLE 1-5. LIST OF PREPARERS

PERSONNEL	TITLE	QUALIFICATIONS
MASSPORT		
Ms. Janeen Hansen	Director and Project Manager	M.A. in City and Regional Planning from Harvard University. Fourteen years experience in transportation analysis and policy planning.
Dr. Norm Faramelli	Director, Transportation & Enironmental Planning	B.S. in Chemical Engineering from Bucknell University and Ph.D. from Temple University. 10 years consulting experience and 16 years at Massport in transportation and environmental planning.
U.S. ARMY CORPS OF ENGINEERS		
Mr. Peter Jackson	Project Manager	M.S. in Civil Engineering from Stanford University. 25 years experience with the Corps of Engineers in San Francisco District and New England Division in engineering and managing water resources projects.
Ms. Catherine Demos	Marine Ecologist	M.S. in Coastal Zone Management/Biology from University of West Florida. Seven years experience with the Corps. Has written several environmental assessments and EIS's for coastal and marine projects.
Mr. Robert Meader	Engineering Manager	B.S.C.E. from Worcester Polytechnic Institute, M.C.R.P. from Rutgers. Over 18 years experience with the Corps of Engineers in the study and management of inland and coastal navigation projects.

TABLE 1-5 (CONTINUED). LIST OF PREPARERS

Dr. Thomas Fredette	Marine Scientist	Ph.D. in Marine Science from the Virginia Institute of Marine Science at The College of William and Mary. 10 years of experience in the area of environmental impact research, assessment,and monitoring. Program Manager of New England Division's Disposal Area Monitoring System (DAMOS).
NORMANDEAU ASSOCIATES		
Ms. Virginia Treworgy	Managing Corporate Officer and Principal Author	M.A. in Government and Public Policy from Harvard University and is an attorney admitted to practice in Massachusetts. 17 years experience in environmental impact assessment, permitting, and management of Remedial Investigation and Feasibility Studies at state and federal hazardous waste sites.
Ms. Ann Pembroke	Marine Ecologist	M.S. in Marine Biology from University of Delaware. 13 years experience with the firm. Project manager and senior report author for numerous assessment projects dealing with marine issues.
Ms. Sarah Allen	Wetland & Wildlife Ecologist	M.S. in Wetland Ecology from University of Rhode Island. Over 11 years in natural resource research and consulting. Specializes in wetland delineation and jurisdictional assessments, and botanical and wildlife surveys.
Ms. Mary Small	Wildlife Biologist	M.S. in Wildlife Management from University of Maine with emphasis in bird and small mammal ecology. 9 years experience life sciences.
Mr. James Bajek	Dredged Material Specialist	B.A. in Biology from University of North Florida. 17 years experience in the planning, material evaluation, and permitting of dredging projects.

TABLE 1-5 (CONTINUED). LIST OF PREPARERS

Mr. Paul Geoghegan	Fisheries Biologist	M.S. in Wildlife and Fisheries Sciences from Texas A&M University. American Fisheries Society certified fisheries scientist experienced in environmental assessment and population dynamics of fish communities.
OCEAN & COASTAL CONSULTING (OCC)	Marine Engineering, dredging specialists	Provided specialized services in dredge management planning and interpreting ship simulation data for disposal cell design.
APPLIED SCIENCE ASSOCIATES (ASA)	Fate and Transport Modeling	Provided specialized services in fate and transport water quality modeling for aquatic disposal facilities.
BOELTER & ASSOCIATES		
Ms. Alice Boelter	Principal Port Planner	Master in Public Policy studies from the University of Michigan. Over 20 years experience in urban planning and project permitting.
WADE RESEARCH, INC.		
Dr. Michael J. Wade	Principal Scientist, Marine Organic Geo-chemist	Ph.D. in Marine Geochemistry from University of Rhode Island. Dr. Wade provides chemical oceanographic consulting services to government and industrial clients. He is an organic geochemist with over 20 years technical and management experience in a variety of research programs, with special emphasis on pollutant fluxes in the environment.
DIAMOND ENVIRONMENTAL ASSOCIATES		
Ms. Harriet Diamond	Regulatory Specialist	Masters in Biological Oceanography from the University of Rhode Island. 15 years experience in environmental consulting, permitting and planning.
WARNER & STACKPOLE		
Mr. Michael Leon	Legal Counsel	Masters in City and Regional Planning. Partner with the law firm Warner & Stackpole and head of the firm's Environmental Law Group. Admitted to practice in Massachusetts.
LINOWES & BLOCHER		
Mr. Kenneth Kamlet	Legal Counsel	Masters in Biochemical Sciences. Environmental counsel in securing necessary wetlands and other environmental regulatory approvals.

Chapter Two: Project Description

This chapter describes the elements of the final preferred option for the design of the BHNIP. This chapter also considers issues in response to comments received on the DEIR/S regarding project design alternatives that minimize or eliminate the need for the project. This Chapter begins with a description and comparison of the various alternative dredging plans that were considered in the Corps' economic impact analysis which formed the basis for Congressional approval of the project. This chapter concludes with the maintenance dredging plans for the 50-year life of the project and a description of potential future demonstration projects to be undertaken prior to maintenance dredging of the completed BHNIP.

2.1 PROJECT DESIGN ALTERNATIVES

The project design alternatives evaluated for the BHNIP include:

- no action,
- maintenance dredging only without improvements,
- full project to the proposed depths,
- expanded project,
- reduced project, and
- delayed project.

Both the MEPA certificate and NEPA guidance require that the FEIR/S provide a discussion of the consequences of not carrying out the project, often referred to as the "No Action" alternative. The BHNIP has been evaluated in terms of two scenarios under the "No Action" alternative. The first considers no improvement and no maintenance dredging. The second considers no improvement dredging, but with maintenance dredging to maintain currently established channel dimensions.

2.1.1 No Action, No Maintenance Dredging

This alternative assumes that no dredging activity, including maintenance dredging, would take place. Silty material is continually deposited in the navigation channels and berthing areas by rivers and tidal action. Organic material is deposited from combined sewer outfalls (CSO's) and the outfall pipe at Deer Island. Sediment deposited in the channels and berthing areas, since they were last dredged, will be referred to as "silt" in this report, to differentiate it from underlying ("parent") material (blue clay, gravel, etc.) and rock proposed to be dredged in the BHNIP.

The authorized channel depths in Boston Harbor were last maintained in 1983 when dredged material was disposed at the Massachusetts Bay Disposal Site. On average, the Reserved Channel and turning areas, Mystic River and the Inner Confluence, and Chelsea Creek have a siltation rate of less than 0.2 inches, 0.2 inches and 0.8 inches per year, respectively. This average rate, however, does not account for specific areas that shoal much faster and which require dredging more frequently. Areas within

the tributaries that tend to shoal at substantially higher rates than the averages cited eventually control navigation through the tributaries. Not maintaining the channels to the currently authorized depths is increasingly making the port unable to accommodate the present shipping fleet of deep draft container ships and petroleum tankers. Currently these vessels draw at least 36 feet to 37 feet if loaded for a minimally economical operation. Some transits, particularly in the Chelsea Creek, must be made in daylight hours. There are limited opportunities for such transits at high tide, especially during the winter months. Limited tidal operations are not consistent with efficient shipping, cargo handling or scheduling. Ultimately, more material would have to be shipped into Boston via barges, necessitating more trips, higher transportation costs, and greater exposure to risks of accidental spills (see Section 1.1).

Leaving the top layer of silt material in place continues to expose marine organisms, that live in or use the area, to contaminants. This material is also subject to continual resuspension in the water column during vessel transits in shallower areas. Removing and confining the material reduces this risk of exposure. The environmental or economic benefits accrued by leaving the material in place are few. MWRA (1993) has reported that with the reduction of toxics and solids in their discharge, cleaner sediments will settle over the older, more contaminated sediment. Non-point source pollution, such as urban runoff, also contributes to the contaminant load. However, several years would be needed to cover the existing sediments with the cleaner material. Therefore benefits are provided by dredging the silt before new deposition occurs.

The no action/no maintenance dredging alternative also considered relocating appropriate port facilities to the -40 foot Main Ship Channel waterfront. This would eliminate the need to deepen the tributary channels. The 1988 Boston Harbor Navigation Improvement Project Feasibility Report prepared by the Corps of Engineers investigated the construction of pipelines and Inner Harbor offloading facilities. This alternative was found not to be feasible for several reasons. These included the minimal amount of available areas for offloading facilities, cost, and the lack of interest from terminal owners to move their facilities. Relocation of active port terminals to these sites is not readily achievable because of land assembly issues, and because of the rigorous regulatory process that such relocation would trigger. The acquisition costs notwithstanding, the roadway connections, rezoning, potential litigation, and the infrastructure required to establish the port terminals closer to the main ship channel would entail years of effort. The Port of Boston cannot wait for this to happen. The BHNIP needs to occur now.

Although the Main Ship Channel would not need to be deepened, navigational access from the Main Ship Channel to the terminals would likely be required. The terminals would be re-located along the west side in Boston along Northern Avenue and the east side of the Harbor in East Boston adjacent to the -40 foot Main Ship Channel. Much of this area is currently occupied with businesses. Additional dredging would be required from the Main Ship Channel to make these berth areas accessible.

In summary, the relocation of the infrastructure of a major port such as Boston Harbor would require an enormous

amount of funding, relocation of terminals, availability of real estate and construction of fuel pipelines without eliminating dredging. Costs for this type of non-structural alternative would not be shared by the Federal government. Infrastructure rebuilding would be the responsibility of the individual terminal owners and appropriate State and local governments.

2.1.2 No Action, with Maintenance Dredging

The no action, with maintenance dredging (to -35 feet MLW) alternative, would allow the Boston Harbor Federal Channels and the project berths to remain in their existing configurations. Table 2-1 lists dates of the last dredging in each tributary (not including berths) as well as projections of annual and project life (50 yrs.) accumulation. The no action, with maintenance dredging alternative would be analogous to maintaining the currently authorized depths. This consists of three main entrance channels, -27, -30 and -35/40 feet MLW converging at the Outer Confluence in President Roads. A -40 foot MLW anchorage is located adjacent to the channel at President Roads. From President Roads to East Boston the Main Ship Channel has two 600 foot lanes. The inbound lane is -35 feet MLW and the outbound lane is -40 feet MLW. The 40 foot depth continues upstream at an average width of 700 feet to the -35 feet MLW Inner Confluence Area at the mouths of the Mystic River and Chelsea Creek. Three active deep draft tributary channels, the Reserved Channel, Mystic River and Chelsea Creek are provided with 35 foot depths.

This alternative however, precludes the regional economic benefits of the authorized improvement project described in Section 1.1. Environmental impacts associated with the maintenance alternative include temporary disturbance from dredging and disposal activities, which is comparable to the improvement project. Maintenance dredging would remove primarily silty materials that have been transported into the channels since they were last dredged (Table 2-1). Dredging impacts include temporary and localized water quality degradation from turbidity and release of contaminants into the water column.

Disposal impacts would be dependent on the site selected. Water-based sites would have a temporary increase in turbidity and release of contaminants. Alternative disposal sites evaluated in this report for the BHNIP are also suitable for maintenance projects if the improvement project does not proceed. There are differences between the project and no project options that must be considered in evaluating sites for disposal of maintenance material: volume differences and availability of clean parent material.

Maintenance projects typically remove material from shoal areas to keep the channels open. Therefore maintenance dredging most likely will take place over a longer period of time through smaller projects than that required for the BHNIP. Smaller capacity sites such as the shoreline sites or lined landfills, that may be inefficient for the higher full project volumes, may be more suitable for use in normal maintenance projects.

Because maintenance dredging does not involve removal of parent or clean material, those disposal alternatives that depend on containment in parent material,

such as in-channel disposal, or borrow pits or confined aquatic disposal, are less feasible.

2.1.3 Full Project - Three Channels, All Berths

Over the past decade various dredging alternatives, which fulfill the project purpose and need, have been investigated to identify their economic and environmental implications. The results of these investigations are contained in the 1988 Feasibility Report. The recommended plan, authorized in 1990, includes the following features: deepen Reserved Channel and Mystic River from -35 feet to -40 feet MLW and Chelsea Creek from -35 feet to -38 feet MLW. Also included are non-structural boundary modifications in the Presidents Roads area. Project berths located in these three tributaries would also deepen their areas to the same depths as the adjacent channel to accommodate deeper draft ships (see Figure 1-3 through 1-7).

Deepening Boston Harbor will involve the removal of approximately 2.8 million cubic yards of silt, clay, and rock (Table 2-2). An additional 1.8 million cubic yards of clean parent material would be removed to provide for in-channel disposal. Short-term impacts from dredging will include localized turbidity, and when silty material is dredged, a temporary release of contaminants to the water column. Rock blasting will also have an impact on the biota in the area immediately surrounding the blast site. The long-term benefit from the project is the removal and sequester of silty material from biological resources. As the water in Boston Harbor becomes cleaner from additional sewage treatment, the isolation of contaminated sediment will also enhance the biological health of this Harbor.

Engineering design of the project must consider safety factors. For this reason a ship handling simulation study was conducted and evaluated to determine the impact of channel improvements on the docking masters' perception of safety. The summary report was included in Appendix D of the Draft EIR/S published in April 1994. The objectives of the simulation were to provide an "as-near-to-reality-as-possible" real-time simulation of the proposed changes and to record the actions and opinions of docking masters currently working in the Harbor. Existing channel conditions and vessel operations were tested and compared with the project channels and vessel operations of the same vessels loaded to greater drafts. Environmental and physical conditions were held constant except for forces acting on the more heavily laden ships. The results of the ship simulation study ensured the safety of the improved Harbor and minimized the area to be dredged.

Based on the ship simulation study and the economic analyses, the preferred navigation improvement project, as authorized, consists of the following components:

2.1.3.1 Reserved Channel

The existing 430-foot wide, 4,500-foot long, Reserved Channel will be deepened to -40 feet MLW from its existing -35 foot MLW with the exception of its upper 1,340 feet which will remain at -35 feet MLW. The width of the project channel will vary. The northern limit will be relocated inward by 15 feet for the entire length of the deepened channel, the southern channel limit will be relocated inward by 32 feet from the confluence with the main ship

channel, along the Conley Terminal (Berths 11, 12 and 13) to the upstream limit of Conley Berth 11 resulting in a width of 383 feet for a distance of approximately 2,950 feet. Upstream from Berth 11 the existing southern channel line will be relocated 15 feet inward to the upstream limit of the deepened channel resulting in a width of 400 feet. The 32-foot wide reduction in the width of the existing channel along the Conley Terminal Berths 11, 12 and 13 will be deauthorized and become berth area. The channel will be widened to provide maneuvering area at the confluence of the Reserved Channel, Main Ship Channel and Drydock Channel, and deepened to -40 feet MLW, relocating the established harbor lines accordingly. A trapezoidal area of the -35 foot main ship channel, opposite the Reserved Channel, will be deepened to -40 feet to provide required maneuvering area.

Approximately 159,700 cubic yards (cy) of silty (maintenance) material and 438,800 cy of parent (new) material will be removed from the channel. Approximately 34,100 cy of rock will be blasted and removed in the maneuvering areas at the mouth of the Main Ship Channel. The Conley Terminal berths 11-13 and the Coastal Oil berth are direct project beneficiaries required for the improvement project. Approximately 45,900 cy of material will be removed from the Conley Terminal berthing area 11-13 to deepen it to -40 feet MLW. The Coastal Oil berth has been deepened recently and does not require dredging. The following berths do not receive direct benefit from the BHNIP: Boston Edison Intake and Barge Berth, Conley (Berths 14-15), and Boston Army. These berths will remove about 152,800 cy of total material. Dredging of the North Jetty berth on the Main Ship Channel will generate about 16,200 cy of material. The total amount of dredged material to be removed from Reserved Channel and associated work in the Main Ship Channel, including rock, is about 847,500 cy. The volumes are detailed in Table 2-2.

2.1.3.2 Mystic River Channel

About 5,670 feet of the existing 6,570-foot long -35 foot MLW Mystic River Channel would be deepened to -40 feet MLW. The Mystic River Channel is 580 feet wide through the Tobin Bridge, 740 to 700 feet wide from the bridge upstream to the Island End River, widening to 930 feet at the Island End River, widening further to 960 feet at the Exxon Terminal then narrowing to 440 feet at the Distrigas pier continuing upstream to the Prolerized Wharf to a depth of -40 feet MLW. Areas of the channel not requiring deepening would remain at their authorized depth of -35 feet MLW.

Also included with the Mystic River channel design is the Inner Confluence area. The existing 35-foot deep Inner Confluence Area would be deepened to -40 feet MLW as well as about 2,500 feet of the -35 foot Main Ship channel downstream of the Inner Confluence. This will improve the maneuverability of larger vessels as part of the modification to improve the approach to the Mystic River Channel.

In the Inner Confluence and Mystic River approximately 471,900 cy of silt, 791,800 cy of parent material and 54,000 cy of rock will be removed from the Channel. This includes deepening a part of the -35 foot MLW Main Ship Channel just south of the Inner Confluence.

Three of the berth areas that are direct project beneficiaries will be deepened to -40 feet MLW, with the following approximate amounts of material removed: Distrigas, 13,800 cy; Prolerized, 7,600 cy; and Moran Terminal, 6,600 cy. Boston Edison who uses the Exxon berth, are direct project beneficiaries. Exxon is currently at the -40 feet depth and does not need to be dredged. A berth that is not a project beneficiary will also be dredged. Revere Sugar, to be deepened to -40 feet, will be removing 12,800 cy.

2.1.3.3 Chelsea Creek Channel

The existing -35 foot MLW Chelsea Creek Channel will be deepened to -38 feet MLW, and widened to the fenders at the bridge openings. Chelsea Creek was investigated for deepening to -40 feet MLW, but this depth was found to be economically unjustified. The incremental cost of deepening the channel from -38 feet to -40 feet was not offset by the additional benefit a deeper channel would provide. The significant cost was the relocation or protection of the subsurface utility crossings, primarily the Boston Gas siphon. Utilities in the Chelsea Creek Channel will be modified to accommodate the deepened channel. These include: Boston Edison Cables (moved), MWRA Water Tunnels (removed and moved), MBTA Cables (moved), and the Boston Gas Siphon (protected).

Approximately 230,000 cy of silt and 320,100 cy of parent material will be removed from the Channel. The following berths are direct project beneficiaries. The Gulf Oil berthing area will be deepened to -38 feet MLW resulting in the removal of 12,300 cy of material. Eastern Minerals plans to deepen their berthing area to -38 feet MLW and remove approximately 39,900 cy of material. Northeast and Coastal are also beneficiaries. They have, however, already deepened their berths and do not need to be dredged.

2.1.3.4 Main Ship Channel

In addition to the project tributaries, three berthing areas along the main ship channel will also maintenance dredge their berths. These berths do not receive direct benefit from the BHNIP: Boston Army Base (1-3) which will remove about 40,000 cy of dredged material (of the 128,500 total for Boston Army 1-9), about 16,200 cy of dredged material will be removed from North Jetty, and 17,600 cy of dredged material will be removed from Mystic Piers 1, 2, 49, 50.

2.1.3.5 Non-Structural Improvements At Presidents Roads

Specific Federal channel limits will be designated through President Roads to connect the Entrance Channels at the Outer Confluence with the Main Ship Channel limits. This will increase the size of the President Roads Anchorage from 350 to 420 acres. The area will require a hydrographic sweep survey and relocation of several navigation buoys to ensure a safe navigation channel. No dredging is required.

2.1.3.6 Summary

All told, the full project (including channels, beneficiary berths, other berths, and related areas) will remove about 1,100,000 cy of silt, 1,680,000 cy of parent material, and 88,000 cy of rock, all measured in place. Because of expansion during removal and handling, the

corresponding volumes required for disposal are approximately 1,360,000 cy of silt, 2,020,000 cy of parent material, and 132,000 cy of rock.

In additional 1.8 million cy of parent material will be dredged to provide in-channel silt disposal for 1.3 million cy of silt, allowing for 3-feet of headspace for capping. The total parent material to be dredged from the Federal channel is therefore, 3.3 million cubic yards as follows:

Mystic/Inner Confluence:
792,000 cy (for authorized depth)
1,333,000 cy (extra for in-channel)

Chelsea:
320,000 cy (for authorized depth)
447,000 cy (extra for in-channel)

Reserved/Main Ship:
439,000 cy (for authorized depth)
0 (extra for in-channel)

TOTAL:
1,551,000 cy (for authorized depth)
1,780,000 cy (extra for in-channel)

Future maintenance dredging of the tributaries in the Full Project is anticipated to yield 95,000 cy for the Reserved Channel, 1,300,000 cy for the Mystic River, and 365,000 cy for the Chelsea Creek over a 50-year economic project life. Approximately 1,760,000 cy of silty material from the tributaries will require removal and disposal at various times over the next 50 years.
In addition to the tributary channels, maintenance of the Main Ship Channel and the anchorages is required to maximize the benefits of all the interdependent projects that support the Port of Boston. This maintenance would require removal of about 4,365,000 cy of material over the 50-year design life.

2.1.4 Expanded Project

Deepening the tributary channels below the currently authorized -40 feet MLW and -38 feet MLW can only be accomplished downstream of the numerous Boston Harbor Tunnel crossings, leaving the Reserved Channel as the only tributary capable of being dredged to greater depth. In order to deepen the Reserved Channel, two major steps are required. First, a non-Federal cost sharing sponsor must request the project to the Corps to initiate an economic feasibility study. The Corps then determines the economic feasibility (benefit to cost ratio) by comparing the improvements in navigation efficiency by providing additional depth to the cost of implementation and maintenance. Second, if the project qualifies for Federal participation, Congressional authorization and appropriations are required to complete design and construction.

The benefits of deepening must outweigh the cost of design and construction and future maintenance of the increased depth increment. The cost must include the deepening of not only the Reserved Channel but also the Main Ship channel, President Roads, and the Broad Sound North Channel including Finn's Ledge. In addition to the navigation channels, the benefiting berths must be deepened as well as a portion of the President Roads anchorage. This feasibility process would evaluate incremental depths, including 45 feet, to optimize the efficiency of the project. The 1988 Feasibility Report included an evaluation of incremental depths for the tributaries, beyond 40 feet, of 43, 45, 47 and 50 feet. It was concluded

at that time that these depths were not necessary to satisfy the needs of existing or projected vessel traffic based on benefits and costs then calculated. If operations at the Reserved Channel based terminals are expanded or changed, further analysis in the future may be warranted. However, at the present time, no steps have been taken to evaluate deepening the Reserved Channel or its approaches.

The current project was authorized in the Water Resources Development Act of 1990 (WRDA 90). Minor changes to a project are allowed within the discretion of the Chief of Engineers, however an increase in depth would be considered a change requiring further congressional authorization.

2.1.5 Reduced Project

The Navigation Improvement Project is made up of improvements to three tributary channels. The economic feasibility analysis prepared for the feasibility report and subsequently updated, viewed each tributary channel and its berth areas as individually justified. Each tributary channel can therefore be treated as a separate project or in any combination with other project tributaries.

A reduced project could result from economic justification failing for one or more of the tributaries as a result of increased cost or reduced benefits to the project. Economic justification is reviewed periodically up to the time of construction. Corps project evaluation procedures require that a project have benefits at least as great as project costs, or expressed differently, have a ratio of benefits-to-cost that is greater than or equal to one.

Another reduction in the project, a temporary reduction, could occur if there is a delay in one or two of the tributaries due to changes in the project area that might require reformulation of the authorized plan. An example would be the replacement of the Chelsea Street Bridge by the City of Boston. There is interest in reviewing the navigation channel to consider its widening and deepening to accommodate larger vessels. Changes of this magnitude would require reformulation of a plan because the benefits would change and may require authorization by Congress to implement. Such a delay in the Chelsea Creek portion of the project would not impact the Mystic and Reserved portions of the project which could move ahead independently. Such a delay in dredging the Chelsea Creek could complicate the in-channel disposal option since a portion of dredged material from Reserved Channel will be disposed in Chelsea Creek. The lost capacity may be made up with additional cells in the Inner Confluence Area. Once reformulated, the Chelsea Creek improvement could proceed. Minor changes to channel lines and berths would not delay the project.

A reduced project may also result from reductions in the dimensions of the project such as minor realignment of channel lines, berth areas, etc. Unless these changes have substantial impact on the economic justification of the project, or require reformulation and reauthorization, they should not delay or reduce the project to any great degree. It is anticipated that a number of these minor reductions and possible enlargements to the project will occur as the design is finalized.

2.1.6 Delayed Action

The present timetable is for the Boston Harbor Dredging Project to begin early in 1997. Any delays (>4 years) in this

schedule could noticeably increase the impacts to shipping interests already experienced in the Port of Boston. Continued siltation will steadily reduce the useable channel and ship berth depths and could eventually create unusable and, in some instances hazardous, conditions for the larger vessels. Maintenance dredging of shoaled areas would be required to maintain navigational safety even in the absence of the improvement project. Reductions in the useable draft for the project channels and berths could limit usage by more vessels to high tide and increase the need for lightering. Also, this may result in a reduction in the size of vessels transiting Boston Harbor, increasing the overall number of vessels needed for handling the same quantity of goods. Vessel maneuverability could also be impaired for larger vessels such as the LNG (Liquified Natural Gas) tankers that turn in the inner confluence. Constraints on the size of vessels that could utilize the harbor may reduce cargo volumes and overall port employment (see Section 1.1). A reduction in flexibility of ship schedules could ultimately result in the diversion of cargo to other ports. This loss in the cargo market would have a negative impact on the Port of Boston and the New England economy.

The authorized depths in the port of Boston are difficult to maintain since it is the upper "maintenance" silty material that contains the higher contaminant concentrations. This makes finding a suitable disposal site difficult. The Harbor was last dredged in 1983 and maintenance dredging of this and other channels is now already overdue. Delaying the project another 5-10 years could have substantial impacts, by increasing the quantity of material that will eventually require dredging, and increasing the cost. A greater quantity of material coupled with inflation will increase the cost of dredging without a corresponding increase in benefits. The increased quantity will also lengthen the duration of dredging once it finally begins and could affect the project schedule further if the increase in time conflicts with environmental dredging windows.

2.2 COMPARISON OF PROJECT DESIGN ALTERNATIVES

Three major factors differentiate the project alternatives: quantities to be dredged, areas to be maintained or improved, and the timing. The quantities of sediment to be dredged affects:

- duration of dredging
- duration of turbidity plume
- amount of habitat affected
- duration of interference with navigation.

The No Action without Maintenance alternative would, of course, result in no dredging and therefore would have none of these effects. However, without maintenance the siltation will interfere with navigation and may cause hazardous conditions. In turn, the alternative would have other environmental and economic impacts. The No Action with Maintenance alternative would remove only unconsolidated silt and leave the cohesive parent material in place, resulting in virtually the same turbidity, plume and footprint, but reduced duration of dredging compared to the Full Project or the Delayed Project. Because the Delayed Project would encompass dredging a larger component of silt, dredging would take longer and result in a prolonged period of

increased turbidity compared to the Full Project.

The physical limits (both horizontal and vertical) of the dredging alternatives affect:

- socioeconomic benefits
- navigation safety
- potential improvements to bottom sediment quality
- extent of turbidity plume
- area of habitat affected

The changing world fleet requires deeper ports to minimize double-handling of cargoes. The two No Action alternatives would allow shipping to continue in Boston Harbor but would eventually lead to greater and greater reliance on partially loaded vessels, lightering or feeder barges. The No Action with Maintenance dredging alternative has all the potential impacts of the Full Project (because of the silt removed) but without the economic benefits of the full project. Deepening of any of the channels would improve this outlook for specific components of the Port's activities. Petroleum shipping would be aided by dredging in Chelsea Creek, Mystic River and Reserved Channel. LNG shipment would be aided by activities in the Mystic River. Container shipping would be aided by deepening the Mystic River and Reserved Channel. Thus, the Full Project has the greatest potential to benefit shipping in Boston Harbor. These benefits would be reduced for the Delayed Project. Delaying the project could reduce the economic benefits if port costs or navigation conditions cause current port users to use other ports.

The Full Project is the preferred, and congressionally-authorized, alternative for the dredging project. In addition to the removal of all unconsolidated silts required for maintenance, parent material would be dredged to project depths. The purpose and need for the Full Project has been documented (ACOE 1988; and Section 1.1). It offers the greatest benefits to the port of Boston; the impacts associated with the dredging are, as with the other alternatives, temporary. The preferred project alternative can reduce the cost of products shipped through Boston, reduce associated shipping costs, maintain safety, and maintain a workforce engaged in maritime support services.

2.3 FUTURE MAINTENANCE DREDGING

One of the primary benefits of the BHNIP is that the navigational efficiency and safety of Boston Harbor will be increased and future growth of Boston, as a major international trading port, will be supported. This benefit cannot be fully sustained, however, unless future maintenance dredging within the Harbor is performed consistently and the desired channel and berth depths accomplished by the BHNIP are maintained. Future maintenance dredging of Boston Harbor will involve the removal of the upper layer of accumulated silt material from within the channels and associated berths, without the need to remove any of the underlying parent material. The issues associated with maintenance dredging are similar to those associated with the maintenance material component of the improvement project: quantity and quality of the dredged material; disposal site options; potential environmental impacts associated with the dredging operation and with the disposal of the material; and the related costs. The following sections discuss future maintenance dredging for the BHNIP.

Section 2.3.1 discusses the estimated quantity and quality of the material which will be removed during future maintenance dredging. The anticipated dredging cycle, is discussed in Section 2.3.2. Section 2.3.3 describes demonstration projects that are being considered to assess the effectiveness of potential disposal options for future maintenance material. Section 2.4.4 provides a summary of disposal options for future maintenance dredged material.

2.3.1 Quantity and Quality of Dredged Material

The quantity and quality of the material dredged during future maintenance cycles will directly influence both the future dredging cycles and the selection of disposal options for the material. The estimates for the quantity(s) and quality of the dredged material, are that based on information provided in the DEIR/S, provide a worst case representation of future conditions.

2.3.1.1 Quantity of Material

Estimates of the quantity of material dredged from future maintenance activities are based on the estimated rates of sediment accumulation within each of the areas to be dredged. Estimated rates are generally determined from average accumulation rates obtained from scientific studies and/or observations made over periods between dredging cycles.

Sediment accumulation rates within a specific area are dependent upon conditions such as sediment load to the harbor system, tidal flow currents, flood and ebb velocities, circulation patterns, wind and wave action, and the physical stability of the sediments. These conditions, in turn, result in variable accumulation of sediments.

The Reserved Channel and Turning Area have an average siltation rate of less than 0.2 inches per year. The Mystic River and the Inner Confluence have an average siltation rate of 0.2 inches per year. Chelsea Creek has the highest average siltation rate of 0.8 inches per year. The average rates, however, do not account for the variability in shoaling rates which would require that certain areas within those channels/tributaries be dredged frequently enough to produce adequate controlling depths. The average siltation rates within the Main Ship Channel and Anchorages are, on average, lower than those within the Tributaries. The siltation rates vary from 0.03, 0.07 and 0.08 inches per year in the 35-foot, 40-foot Main Ship Channel, and President Roads Anchorage area per year, respectively. Shoaling rates within these areas are also variable. Using these sedimentation rates, the estimated the annual rate of sediment accumulation in cubic yards (cy) over a one year period for the Tributaries, the Main Ship Channel and the Anchorages, over the 50 year project life, are estimated as follows:

SEDIMENT ACCUMULATION OVER 50-YEAR DESIGN LIFE OF PROJECT BY LOCATION
TRIBUTARIES:

Reserved Channel:
95,000 cy
Mystic River:
1,300,000 cy
Chelsea Creek:
365,000 cy

Berth Maintenance:
1,000,000 cy
Total 2,760,000 cy

MAIN CHANNEL:
40-Foot Main Ship Channel:
2,195,000 cy
35-Foot Main Ship Channel:
717,000 cy
President Roads Anchorage:
1,455,000 cy
Total 4,365,000 cy

The 50-year project life starts at the completion of the BHNIP. Future maintenance dredging will continue for the life of Boston Harbor and its use as a commercial port. Funding for future dredging of berths, in order to fully realize project benefits, will be provided by individual berth owners.

2.3.1.2 Quality of Material

The Massachusetts Water Resource Authority's (MWRA) stricter controls on sludge and combined sewer outfall (CSO) discharges into the Harbor, is expected to reduce the amount of contaminants entering the Harbor and, ultimately, improve the quality of the water and sediments. Boston Harbor, however, is an urbanized working port, supporting shipping, commercial and industrial activities. Historically, urbanization results in measurable degradation of the water quality and sediments. The beneficial impacts from the BHNIP and MWRA controls will not be fully realized until some time in the future. Benefits to water quality from stricter water quality controls and the cessation of the discharge of sewage sludge are, however, already becoming apparent in the Outer Harbor at areas around Spectacle Island and Sculpin Ledge Channel in studies performed for the Central Artery/Tunnel Project (NAI 1994). A sampling and testing program of the BHNIP silt and sediment was conducted and the results reported in the DEIR/S. The program used a three tier analytical approach for marine sediment characterization. The three tier approach combines a literature and existing data review, bulk chemistry analysis of the material, and biological testing; all of which are used to determine if the material is suitable for unconfined ocean disposal (see Section 2.2.1 of the DEIR/S).

Based upon the results of the sampling and testing program, the EPA determined that the silt material was unsuitable for unconfined ocean disposal. As water and sediment quality are expected to improve over time, some silt, especially from the Main Ship Channel, may be suitable. However, as a worst case scenario for calculating future maintenance dredging quantities, it is assumed the dredged material will not be suitable for unconfined ocean disposal and that alternative disposalmethods will be required.

2.3.2 Future Maintenance Dredging Cycle

Maintenance dredging can occur as frequently as once every year to once every 20 to 30 years or more. The maintenance cycle is generally established based on a number of factors such as sediment accumulation and conditions within the area to be dredged; navigational status and priority of the dredged area; depths and widths required to produce the benefits that the project was designed to achieve; potential disruptive impacts (i.e biological, socioeconomic, transportation) from the dredging operation; availability of disposal

options for the dredged material; and funding for the work.

The Corps anticipates that an approximate 10 to 20 year dredging cycle, commencing from the completion of the BHNIP, is appropriate for planning future maintenance dredging of Boston Harbor. Based on the annual rates of sediment accumulation estimated for the tributaries, Main Ship Channel and the Anchorages, each ten year dredging cycle would result in the removal of about 1.3 million cy of material, including material from required berths. As time progresses and technologies advance, additional disposal options for the dredged material may emerge for disposal of the maintenance material. For example, technologies may render the material clean or reduce the amount of material considered unsuitable for unconfined ocean disposal. These disposal options and technologies may become commercialized which may reduce the costs of options found to be impractical at this time. Maintenance dredging of Boston Harbor is one of many future dredging projects that can be expected in the Commonwealth over the next fifty years. Dredged channel access to communities with commercial fishing or recreational use harbors will also need to be maintained. As mentioned in the introduction, disposal sites for maintenance material must be provided by non-Federal interests. The Massachusetts Executive Office of Environmental Affairs (EOEA) recognizes the need for a long-term, statewide, dredging management plan and has asked the BHNIP sponsors to develop information in the MEPA and NEPA documentation that could help advance the development of such a plan.

The Corps will be completing a Massachusetts Navigation and Dredging Management Study in July 1995 to provide information on the current and projected future dredging and disposal needs of the State. The Commonwealth and the Corps will continue to work together to identify ways in which to maintain access to local harbors, including Boston, in an efficient and environmentally-sound manner.

2.3.3 Demonstration Projects

Two options presently being considered for the disposal of future maintenance dredged material are capping at open water sites and use of geotextile containers. Both options appear to be viable methods for containment of the silt material; however, unanswered questions as to their efficiency have raised questions about their viability. The use of demonstration projects is a common method by which to test and determine the effectiveness of a product or technology. Demonstration projects are designed to simulate field conditions or utilize actual field sites over a period of time and provide a realistic test of the process or product's efficacy.

Given a project source of suitable material within a reasonable accessible distance of MBDS, the Corps is interested in demonstrating the feasibility of capping. Such a project would not be experimental in that an actual dredging project, with suitable material, would be used. The demonstration phase would be monitored which may require both Federal and non-Federal participation. The timing of such an operation depends on the availability of suitable project material and funding of the monitoring phase. The Corps does not currently plan to demonstrate use of geotextile bags in New England, but will continue to evaluate other projects and demonstrations throughout the country for potential implementation.

2.3.4 Disposal Options for Future Maintenance Dredged Material

Non-Federal interests are responsible for providing the necessary disposal sites for future maintenance material including the lands, easements, rights-of-way, dikes, other containment facilities and the necessary approvals.

Disposal sites considered in Section 4.0 of the EIR/S for the silts from the current project are also primary candidates for disposal of future maintenance material. These include MBDS with capping or other management technology, Subaqueous sites B and E, Spectacle Island CAD and Meisburger sites 2 and 7. Some of these sites may require further evaluation and design before they are used. Capping at the open water sites will require a demonstration of the process.

In the next few years, as the need for dredging of major harbors and/or ports increases, there will be increased pressure to find disposal options for the dredged material. In some instances the dredged material will be cleaner and will require no special method for its disposal. In other instances, like that of the BHNIP, the maintenance dredged material will not be suitable for unconfined open water disposal making the process more complex.
As time progresses and technologies advance, the number of disposal options for future maintenance dredged material from Boston Harbor may increase. New technologies and discovery of new containment materials subsequently increase the number of sites available for disposal of the material. The following section briefly discusses a number of potential options which may be available for disposal of future maintenance dredged material that at this time are not proven or are too costly.

2.3.4.1 Capping

Numerous commentors on the DEIR/S expressed the need for a demonstration project to prove the feasibility of capping as a future option for ocean disposal of the contaminated silt (confined ocean disposal). Since capping has not been demonstrated at MBDS depths, commentors on the DEIR/S felt there was a need to demonstrate its efficacy. If capping proves to be an option for ocean disposal, then the Massachusetts Bay Disposal Site (MBDS) and other open water sites may become viable disposal options for contaminated sediments.
A demonstration project for capping may be conducted at the MBDS using a clean silt material. The demonstration project would include point-depositing clean material by precise positioning of the barge. Once disposal is complete, clean material will be deposited over the contaminated material to form a final cap of approximately 3 feet in thickness. Monitoring of the demonstration site will be conducted over an undetermined period of time. This would likely involve monitoring for a period ranging from one to three years so that the cap can be observed over different weather and oceanic conditions (i.e. intense storms, seasonal variations, variable wave action, tidal flows).

The demonstration project will follow the guidelines under the Marine, Protection, Researach, and Sanctuary Act, the Clean Water Act, and will require consistency with the policies of the Massachusetts Coastal Zone Management Agency (CZM) under 301 CMR 20.00.

If the demonstration project determines that capping is an effective method for the long term containment of silty material at open water aquatic sites, sites where unconfined disposal was previously a concern may become preferred alternatives for future maintenance dredged material. The ocean disposal sites, including MBDS and other open water sites, may become acceptable disposal sites with capping. The short-term impacts associated with the capping process (i.e. temporary disturbance of habitat, short-term turbidity, temporary disruption of traffic) may continue to be a concern at these sites, however, the long term impacts, such as migration of sediments/contaminants and localized water quality impacts, will be addressed with the use of a cap.

The capping and disposal of dredged material at landfills will become less of an option as time goes on. Throughout the Commonwealth, landfill space is fast approaching capacity and space is limited to other, higher priority forms of solid waste. Further, state regulations requiring the closure of many of the landfills will also limit the amount of landfill space available for dredged material. Only the more expensive option of out-of-state lined landfills may be available.

2.3.4.2 Geotextile Containers

A new technology which is being considered as a disposal option for future maintenance dredged material is geotextile containers. The containers, which are generally composed of a pervious sheet of woven plastic (synthetic), monofilament or multi-filament yarn, can be filled with the dredged material and disposed in open water sites. These containers, which come in the form of either geotextile bags or "geocontainers", can range in volume up to 6,000 cy and possibly larger depending upon their application in a project. Geotextile containers have been used in deepwater aquatic environments in the United States (U.S.), Japan and Holland as underwater dikes, breakwaters and similar submerged structures for approximately five years.

Many of the commentors on the DEIR/S expressed interest in the use of geotextile containers as a disposal option for the BHNIP silts. There is limited information regarding the effectiveness of the containers, particularly when used to contain silty material. The consensus of the commentors was that the containers are a feasible disposal option; however, more information is needed to demonstrate their suitability for future disposal of the BHNIP maintenance material.

The Army Corps of Engineers has used geotextile containers at two sites in the U.S.: Red Eye Crossing on the Mississippi River in Louisiana and Marina Del Rey in Venice, California. At Red Eye Crossing, the containers were filled with dredge material and used to construct underwater structures. The containers at Marina Del Rey were placed in a shallow water habitat confined aquatic disposal site. At Red Eye Crossing, the sandy, uncontaminated dredged material was placed in both geobags and geocontainers. In Marina Del Rey, the material was a silty sand contaminated with hydrocarbons and heavy metals. In both instances, the placement of the containers was accomplished easily and accurately with minimal release of materials during placement. The only incident of leakage occurred at Marina Del Ray when the initial container was torn open to insert high pressure piping to liquify the contents to aid release from the

barge. The two projects were implemented in 1994, so no long term monitoring information exists to date.

Other tests on the efficiency of geotextile containers were performed by the U.S. Army Waterways Experiment Station in Vicksburg, Mississippi. One set of samples placed in geobags were shown to release a small amount of fine-grained material after being dropped. Other tests to determine the effectiveness of the geotextile fabric to contain heavy metal contaminated materials were conducted; however, results were inconclusive, due to the lack of long-term studies. In April 1995 a single geotextile container was dropped in the New York Harbor area. Test data is still being analyzed.

A major constraint on the use of geotextile containers is the time consuming and labor intensive process required for their use. The containers must be assembled, placed onto the barge, unfolded, secured and, after being filled, must be sewn together properly and then placed at the disposal site. The entire process can require up to eight people and can take one to two hours per container, substantially increasing the dredge time and cost of the project.

The Corps is not planning a demonstration project in Boston Harbor using geotextile containers at this time. Such a demonstration would require obtaining large amounts of suitable test material approved by regulatory agencies. The geotextile project also requires additional preparation time for the containers and scheduling of the contractor(s). A demonstration project would need testing and monitoring prior to construction of the BHNIP; this would pose a serious time constrain on the project. The capping project is preferred for demonstration and the Corps will likely continue with plans for such a project. The Corps will continue to evaluate other projects that use geotextile containers and their applicability to future maintenance of the BHNIP and other dredging projects.

If geotextile containers prove to be an effective and cost-efficient method for containment of silty/contaminated material, those sites which were considered inappropriate for unconfined disposal (MBDS, BLS) may become viable options with the use of geotextile containers. Similar to the capping process, the containers would seal the material, preventing its migration from the target area. The geotextile containers may also be capped; a method which would further isolate contaminants from the environment.

2.3.4.3 Treatment Technologies

An alternative for disposing of contaminated dredged material would be treatment. As technologies advance in the next ten years, and the need for treatment of contaminated materials is realized, the number of treatment options for future dredged material may increase. As the number of technologies increase so will the options for disposal of the material.

A technology that renders the silt material clean and suitable for unconfined open water disposal would address the issues regarding disposal because MBDS is available for the disposal of clean material. Disposal options such as land disposal or reuse of the silty material would also be reasonable alternatives if the material were clean. Other technologies that could reduce the amount of material would increase future disposal options in that capacity of the disposal sites would be less

of an issue. Technologies that render the material clean and reduce both the volume would reduce disposal concerns and regulatory constraints.

Currently there are commercial technologies available that have been used successfully on materials similar to the BHNIP silt (see Section 3.5). The largest constraint on the use of these technologies for the BHNIP silt is their implementation, cost, limited capacity to process large volumes at a substantial flow rate, and the by-product that still needs confined disposal. The time frame required to design, permit and construct a treatment facility in Boston Harbor is approximately 2 to 4 years; a time frame beyond that for use of the BHNIP material.

Treatment of future maintenance dredged material from Boston Harbor, however, may be a practicable disposal alternative. With a commitment of funding and staff time from resource agencies there may be time prior to the first maintenace dredging (ten years) for designing, permitting and constructing a treatment facility and for carrying out a demonstration project. Within the ten year period, other dredging projects in the state will increase the need for treatment thereby increasing the pressure to construct such a facility. The increase in the number of technologies which may be available in ten years may further result in decreased cost, which may make treatment a practicable disposal alternative for future maintenance dredged material.

TABLE 2-1.

MAINTENANCE DREDGING PROJECTIONS FOR THE TRIBUTARY CHANNELS AND THE MAIN SHIP CHANNEL

CHANNEL	DATE LAST MAINTAINED	ESTIMATED ANNUAL RATE OF ACCUMULATION (cy/year)	ESTIMATED 50 YEAR[1]
TRIBUTARIES			
Reserved Channel	None since deepened in 1966	1,900	95,000
Mystic River	1983	26,000	1,300,000
Chelsea Creek	1983	7,300	365,000
TOTAL for Tributaries			**1,760,000**
MAIN SHIP CHANNEL			
40-foot Main Ship Channel	1974	43,900	2,195,000
35-foot Main Ship Channel	1968	14,300	815,000
President Roads Anchorage	1983	29,100	1,455,000
TOTAL for Main Ship Channel			**4,365,000**

[1] A fifty (50) year project life is used for economic evaluation and starts at the timing of completion of the project. This table does not include future maintenance requirements of the berths.

TABLE 2-2.

VOLUME OF MATERIAL PROPOSED FOR DREDGING FROM CHANNELS AND ASSOCIATED PROJECT BERTHS FOR THE BOSTON HARBOR NAVIGATIONAL IMPROVEMENT PROJECT PROJECTED THROUGH 1997 (DREDGE VOLUMES IN CUBIC YARDS[a])

CHANNEL	AREA	TOTAL	ROCK	PARENT	SILT[b]
Reserved Channel/					
Main Ship Channel	Federal Channel	632,600	34,000	438,800	161,600
	Conley 11-13	45,900	0	18,000	27,900
	North Jetty	16,200	0	7,800	8,400
	Boston Army 1-9	128,500	0	0	128,500
	Boston Edison Intake	1,100	0	0	1,100
	Boston Barge Berth	16,100	0	10,800	5,300
	Conley 14-15	7,100	0	2,800	4,300
Mystic River/					
Inner Confluence	Federal Channel	1,317,700	54,000	791,800	497,900
	Prolerized	7,600	0	5,500	2,000
	Distrigas	13,800	0	10,000	3,800
	Moran	6,600	0	0	16,600[c]
	Revere Sugar	12,800	0	3,100	9,700
	Mystic Piers 2, 49 & 50	45,200	0	28,700	16,500
	Mystic Pier 1	17,600	0	8,400	9,200
Chelsea River	Federal Channel	550,100	0	320,100	237,300
	Eastern Minerals	39,900	0	32,700	7,200
	Gulf Oil	12,300	0	5,400	6,900
Subtotal	Federal	2,500,400	88,100	1,550,700	896,800
	Berths	370,700	0	133,200	237,500
TOTAL	In-situ	2,871,000	88,100	1,684,000	1,134,000
	After removal[d]	3,471,000	132,000	2,021,000[e]	1,361,000

[a] Rounded to nearest 1,000 cy

[b] Silt volumes assume 0.5 feet of overdredge into parent material to ensure all silt is removed.

[c] Includes 10,000 cubic yards already removed in 1993 under a reduced project design at Moran.

[d] Expansion factor (20% for silts and parent material, 50% for blasted rock) added for use in computing disposal site requirements for aquatic disposal sites. Material would be dewatered to in-situ volume for disposal in upland sites.

[e] This table does not include extra parent material to be removed for in-channel disposal.

Chapter Three: Disposal Site Alternatives

This chapter of the FEIR/S summarizes the screening process used to develop a short-list of preferred disposal alternatives for the BHNIP generated silt and parent material. MEPA required the overall process used to develop a short-list of potential disposal sites, that were identified in the DEIR/S is described in the next section. As stated in Chapter One, the site screening criteria were modified based on DEIR/S comments in two key areas. The first is the elimination of cost as a fatal flaw screening criterion. Cost is factored into the analysis only to assess the relative cost effectiveness of disposal scenarios determined to be environmentally suitable. Stated differently, cost is part of the practicability screening of environmentally suitable alternatives.

The second change in site screening was eliminating 200,000 cy as a minimum capacity criterion. Capacity is now viewed as only one factor in site screening and is related to the cost of developing a site for a given volume of disposal capacity.

The original MEPA scope required that the BHNIP evaluate disposal alternatives suitable for the current project needs and those alternatives that could provide a solution for future projects. In addition, both MEPA and NEPA require that the EIR/S consider the cumulative impacts of future maintenance dredging for fifty years after construction of the channel improvements that are contemplated.

The remainder of this chapter responds to the requirements for identifying a preferred disposal alternative for the BHNIP as well as for its maintenance dredging and other future dredging projects. This chapter culminates in a short-list of preferred disposal alternatives. Each of these alternatives is assessed against environmental and practicability concerns in Chapter Four to determine a final preferred disposal alternative.

Section 3.5 provides new material not previously available in the DEIR/S. It contains a description, and the results, of a technology survey of potential treatment and handling technologies for contaminated marine silts. Section 3.6 provides new information, since the publication of the DEIR/S, regarding the possible beneficial re-use of parent material at unlined municipal landfills in the Commonwealth. The chapter concludes with the screening of disposal options and the development of a short-list of potential specific disposal sites. It provides a description of each site in terms of existing environmental conditions and describes how the sites could be used for disposal of contaminated marine silts. This section culminates in a short-list of potential sites that are subjected to a detailed environmental analysis and practicability screening in Chapter Four.

3.1 THE EVALUATION PROCESS

The process for identifying disposal sites and alternatives involves a complex mixture of data collection, analysis, synthesis and judgment. The Disposal Options Working Group (DOWG) identified in Chapter One, assisted and reviewed the methodology and findings of every stage of the site selection process.

The DOWG identified several key interests to be served by the site selection process:

1. Recognizing the need for responsible expenditure of public funds as reflected in the number of sites assessed, the level of detail required in data collection to assess the sites, and the development of disposal options which maintain a benefit-to-cost ratio greater than or equal to one for parent material and the least costly, environmentally acceptable, practicable alternative for silt.

2. Meeting federal, state, regional and local environmental laws and regulations.

3. Meeting the objectives set forth in the Massachusetts Environmental Policy Act (MEPA) and National Environmental Policy Act (NEPA) scoping guidance.

4. Providing disposal alternatives flexible enough to allow for changes in the project stemming from public comments, differences in dredging quantities, alterations in project limits, considerations regarding project requirements for phasing of dredging, and the length of time for handling the marine sediments.

5. Satisfying project requirements in terms of site availability, volume (for BHNIP) and duration.

6. Attempting to contribute benefits to long-term regional dredged material disposal needs. The Commonwealth of Massachusetts and various federal and state entities have established a goal of developing a long-term dredged materials management plan to simplify the process for disposing of sediments that are not suitable for unconfined ocean disposal. This plan is in the developmental stages, however, and will not be implementable for the Boston Harbor dredging project. The BHNIP can support the overall goals of the long-range plan by providing a screening process for site selection, by providing baseline information on sites potentially suitable for marine sediment disposal, and by providing excess capacity for future projects such as future maintenance dredging in Boston Harbor.

7. Demonstrating a wise use of over 2 million yards of clean marine sediments by identifying benefits for both the short-term needs of Boston Harbor clean-up and long-term dredged material management disposal needs.

The Boston Harbor Navigation Improvement Project (BHNIP) will generate up to 3.5 million cy of marine sediment and rock (as measured after removal) under the preferred development option. The materials assessment and characterization provided in the DEIR/S indicated that the parent material and rock are suitable for unconfined ocean disposal while the silt may require other options. As stated in Chapter One, the Corps has, in response to EPA comments, adopted the most conservative approach and has assumed that all silt would be unsuitable for unconfined ocean disposal.

Because of the large quantity of material to be dredged, it is assumed that parent material not earmarked for beneficial uses would be disposed at the MBDS. The disposal options evaluation focussed primarily on the silty maintenance and berth sediments. The remainder of this section describes the process for identifying alternative disposal sites and disposal options for the approximate 1.3 million cubic yards of this silt material, which is not suitable for unconfined open water disposal.

3.1.1 Identification of Disposal Concepts

The objectives of the disposal alternative analysis and screening process were to:

- identify potential disposal sites
- analyze and combine sites with other sites/technologies into disposal options on the basis of environmental considerations
- develop disposal options which meet the interests identified for the project.

The screening procedure consisted of an iterative process involving the development and application of evaluation criteria to a broad list of sites to eliminate infeasible disposal sites and to choose those that would result in the least environmentally damaging alternative. The ultimate aim of the disposal alternatives analysis was to identify a range of practicable alternatives which could be used for the BHNIP dredged material.

The disposal alternatives analysis process began by identifying generic types of sites. Identifying generic types ensured that no disposal opportunity would be left uninvestigated in meeting the MEPA requirement for consideration of upland, nearshore and open water alternatives. NEPA requires the consideration and evaluation of all reasonable alternatives. In general, two broad classes of sites were developed by the project team, Land-based Sites and Aquatic Sites. A general description of each category follows.

3.1.1.1 Land-Based Alternatives

Land-based disposal alternatives generally include landfilling or landfill capping, and confined disposal which may incorporate habitat creation, and commercial reuse. Use of land-based sites must comply with a variety of federal, state, and local laws and regulations. In addition, availability of landfill space and capacity, the logistics of dewatering, and the difficulties and costs associated with transporting the dredged material from the dredging site to the disposal area are important considerations in the feasibility analysis of land-based options. Disposal options which fit into the general land-based class are described in the following paragraphs.

A. Landfilling

Landfilling involves the disposal of d redged material in existing, permitted, lined landfills or for use as daily cover. In order to use dredged material as daily cover for sanitary landfills sufficient land surface area must be available to dewater the dredged materials to a suitable solids/water ratio. Daily cover of sanitary landfills has several benefits including the prevention of landfill pathogens from being carried offsite by animals, use in odor

control, and as a fire retardant. For this category, Project team personnel, and the DOWG, developed a list of licensed, lined landfills for further evaluation.

Once a sanitary or hazardous landfill has met capacity and is ready to be closed, dredged material with appropriate physical and chemical characteristics can be used as a final cover or cap. In addition to the criteria for using dredged material as a daily cover, a final cover must meet minimum permeability standards, be designed to support vegetation to improve the site's aesthetics, and reduce the potential for erosion. Application of Boston Harbor dredged materials as landfill cover would be a beneficial use. If suitable, it could also result in habitat creation. For this category the Project team, and the DOWG, developed a list of former or closing landfills for evaluation.

B. Inland and Coastal Confined Disposal Facilities

Confined Disposal Facilities (CDFs) are engineered structures that are generally lined and diked, and are designed to retain dredged material solids while allowing water to be released from the containment area. A variety of site design features are required for CDFs including a perimeter retaining dike, a weir structure for release of excess water, and the development of an access road. Effects on surface water, groundwater, air quality, and plants or animals depend on the nature and characteristics of the dredged material, management and operation of the disposal site during and after dredging, and the proximity of the disposal facility to potential receptors of contaminants. Possible beneficial aspects of the development of CDFs include the potential for upland habitat creation/mitigation or filling quarries or mines into developable land.

CDFs are designed and constructed to be used over a span of many years, storing materials dredged periodically over the design life. Therefore, long-term storage capacity of a CDF is a major factor in design and management. The Project team and the DOWG identified land-based sites which could be suitable for the development of a CDF for further evaluation. These sites were categorized as inland if the immediate receiving waters are freshwater, and coastal if the immediate receiving waters are estuarine.

3.1.1.2 Aquatic Alternatives

Aquatic disposal is generally accepted for marine dredged material if environmental data indicate that water column and benthic effects are acceptable. If the water column or benthic effects are unacceptable under an open-water, un-capped scenario, aquatic disposal with restrictions may be considered. These restrictions involve disposal techniques such as capping and confined aquatic disposal that will reduce water column and benthic effects.

A. Shoreline Facilities

Nearshore aquatic habitats could be created as a result of shoreline containment area construction. Typically, this would involve direct placement of dredged material into existing shallow or intertidal sites to create new habitats. The types of beneficial habitats which can be created are intertidal wetlands (restoration and creation); migratory and nesting areas for

waterfowl and shorebirds; and various underwater habitats such as reefs, shellfish beds, and seagrass meadows. In Boston Harbor, the use of abandoned piers as containment areas may also provide the benefit of capping potentially contaminated materials in place. Bulkheads or other containment structures may be necessary at many shoreline facilities to confine the dredged material on-site.

The nature of the dredged material, the benefits gained from the new habitat versus the lost benefits associated with the old habitat, and the stability of the site are issues that need to be considered for these shoreline facilities. If the material is of unacceptable quality or the site of the dredging is a great distance from the site of beneficial use, reuse of the dredged material may not be practical. The Project team and the DOWG identified several shoreline sites in Boston Harbor which may be created or enhanced by the placement of some portion of the BHNIP dredged material.

B. Subaqueous Depressions and Borrow Pits

Existing subaqueous depressions (e.g., historic sand and gravel mined coastal areas) or created borrow pits can be used for disposal where the walls of the depression or pit provide lateral containment of the dredged material. These sites can range in size from a few feet to tens of feet deep and from a few acres to many hundreds of acres in size. Dredged material could be disposed of in depressions or borrow pits as long as the location is suitable for capping. The cap would be designed to prevent potential contaminants from entering the water column or the food chain. The selection of sites on which to locate borrow pits needs to be based on an evaluation of potential environmental, hydrodynamic, economic, social, and cultural/historic impacts on the Boston Harbor and Massachusetts Bay region. The use of depressions and pits would reduce the lateral extent of a disposal operation, thereby reducing both physical benthic effects and the potential for release of contaminants.

The project team and the DOWG identified several subaqueous depressions and potential borrow pit sites in Boston Outer Harbor for inclusion in the list of sites for screening.

C. In-Channel Disposal

In-channel disposal consists of excavating a trench within the navigation channel limits into the parent material, filling the trench with contaminated silts, and using granular materials as capping material. The configuration of the trench would be designed so, that upon completion of filling and capping, final contours would match the previous or improved harbor bottom contours. This alternative has the advantage of being located in an already impacted area (i.e., the navigation channels) although water quality and biological impacts as a result of the double handling of dredged materials would need to be carefully evaluated. The project team and the DOWG identified several sections of the Boston Inner Harbor navigation channels where In-Channel disposal may be feasible.

D. Existing Ocean Disposal Sites

Shallow ocean disposal sites are generally designated sites on the continental shelf. This practice consists of placing silty material in the disposal area and then rendering the material immobile by capping it with "clean" dredged material. The placement of clean material over material considered potentially harmful is subject to careful monitoring during placement and after closure. The cap is intended to isolate contaminated sediments from the water column. The cap would prevent or reduce the accumulation of potentially harmful constituents in the water and biota of the disposal areas, and avoid the potential for long-term (chronic) impacts that might occur if the dredged material were left exposed to the natural environment. The resulting disposal site would be a mound of dredged material above the ambient ocean floor. This alternative may be feasible at previously used dredged material disposal sites, such as the Boston Lightship Disposal Area.

The Massachusetts Bay Disposal Site (MBDS), located approximately 20 miles off the Massachusetts coast, has been used for unregulated ocean disposal activities prior to the 1970s. The MBDS has recently received site designation status as an EPA approved national disposal site. The continued use of the disposal site would center potential impacts on existing disturbed habitats, protect the existing biological conditions in other undisturbed areas in the Massachusetts Bay, and lessen potential conflicts between interested parties.

The MBDS would receive the parent material and rock remaining after beneficial uses have been completed. The sediment characterization performed for the Project indicates that this material is suitable for unconfined, ocean disposal. The silt material from the project has been determined as unsuitable for unconfined MBDS disposal, either capped or unconfined and therefore, this site is dropped from further consideration for this project. It's use for the disposal of future maintenance material will require additional studies, demonstration projects or both.

3.1.2 Identification of Potential Disposal Sites

As a starting point for identifying disposal alternatives, a wide range of sites were developed from a number of sources to create a "universe" of sites from which potential disposal areas could be extracted. The sources for the universe of sites included potential disposal sites from the Central Artery/Tunnel Project, the MWRA Residuals Management Facilities Plan (Black and Veatch 1987), Massachusetts Bay Disposal Site Designation, an EPA study on nearshore disposal facilities (Metcalf and Eddy 1992), and conversations with local, state and federal agencies. The process through which these conceptual disposal alternatives were evaluated, and by which specific sites were identified, and evaluated, is detailed in Appendix E of the DEIR/S. A summary of the process is provided herein.

3.1.2.1 Phase 1 Site Screening

The BHNIP disposal site evaluation process consisted of three phases. The Phase I screening process was limited to identifying fatal environmental impact

flaws of particular sites. These fatal flaws included:

- water supply wells located on a site
- sites within a sole source aquifer
- sites within the estimated habitat of rare and endangered species
- sites in or abutting state parks
- sites within Areas of Critical Environmental Concern (ACECs)
- sites containing a 21E hazardous waste property
- upland sites with less than 15 acres of developable land

Landfills were first screened against requirements for accepting dredged material and for being permitted for use until at least 1996. Disposal and stockpiling capacity and distance from the dredging locations were also used as screening criteria on those landfills that met the first two criteria.

Sites were categorized into land-based and aquatic sites. Land-based sites included inland and coastal sites and landfills. Aquatic sites included shoreline facilities, subaqueous depressions, borrow pits, in-channel trenches and existing open water disposal sites. The universe of sites in all categories that made up the first phase screening process consisted of the following:

- 312 land-based inland and coastal sites;
- 21 landfills; and
- 21 aquatic sites

An additional 22 sites within the various categories were identified in consultation with the DOWG and agency personnel. This consultation also resulted in limiting disposal site selection to sites within the Commonwealth. As stated earlier, the MEPA scope indicated an interest in using the information gained in this project to help resolve regional long-term dredging disposal needs in the Commonwealth.

The Phase 1 screening resulted in the following number of sites remaining as potentially suitable for disposal purposes:

- Land-based inland - 14
- Land-based coastal - 12
- Landfills - 4
- Aquatic shoreline - 10
- Subaqueous depressions - 6
- Borrow pits - 4
- In-channel trenches - Not identified or screened in Phase 1
- Existing open water sites - 2

The list of sites remaining after the first phase site screening (Table 3-1) were presented at a meeting of the DOWG on January 25, 1993.

3.1.2.2 Phase II Site Screening

Phase II screening consisted of evaluating potentially acceptable disposal sites against objective criteria relevant to the environment and physiography of the site. Criteria were used that reflected regulatory guidelines (e.g., 404 (b)(1) dredge and fill guidelines; Clean Water Act, Massachusetts Coastal Zone Management regulations) and requirements, (especially Massachusetts's Wetlands Protection Act

and Site Suitability Criteria for Solid Waste Site Assignments). Criteria recommended by DOWG participants or identified in other dredged material disposal site screening documents (e.g., Metcalf and Eddy 1992) were also included.

While each criterion is important, certain criteria stand out from the list as potential deciding factors in the site screening process. To aid in discriminating between the most important and less important criteria; each criterion was assigned a "P" (priority) or an "S" (standard) classification. "Priority" criteria are those that require compliance with a specific regulatory criterion. Inability to meet priority criteria could become a fatal flaw. "Standard" criteria are important to the overall evaluation of a site's suitability but do not rise to the level of the most stringent standard or, represent a potentially fatal flaw. Categorizing the criteria into P and S groupings enabled a semi-quantitative screening in addition to the standard qualitative analysis.

Phase II criteria were applied to all sites identified as potentially feasible after Phase I, as well as several additional sites identified with the assistance of the DOWG (see Table 3-1). A semi-quantitative evaluation of sites was performed for each disposal site category. Within each disposal site category, site "scores" were compared to focus attention on the most promising sites. Criteria that were not met were examined carefully to evaluate whether the concern could be avoided or reduced through site planning and management, or readily mitigated. Data for all sites were examined both quantitatively and qualitatively before determining whether a site should be short-listed.

The results of the Phase II screening were presented to the DOWG on April 15, 1993. Discussion at this meeting and subsequent investigations revealed additional information and issues regarding many sites that resulted in further modification of the short-list (Table 3-1).

In particular, the elimination of Rowes Quarry (MAL-01) at the end of the Phase II screening raised considerable comment in Working Group meetings because this site had been short-listed by MWRA for landfilling sludge from the Deer Island wastewater treatment facility.[1]

Several agencies commented that Rowes Quarry had been dropped from the list of potential disposal sites in the DEIR/S without adequate explanation. The project team revisited the site, reviewed the existing information on the site, and has identified several technical, environmental, social, and permitting issues that detract from the suitability of Rowes Quarry for silt disposal. These issues are discussed below.

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1 USEPA. 1990. Public record of decision on the "Final Supplemental Environmental Impact Statement, Long Term Residuals Management for Metropolitan Boston". U.S. Environmental Protection Agency. Boston, MA.

A. Technical

According to a technical report[2] rebutting MWRA's selection of Rowes Quarry as a potential residuals landfill site, the quarry is characterized by exposed fractured bedrock, with groundwater within 1 to 3 feet of the ground surface. Groundwater was also observed discharging from the exposed northeast quarry wall about 30 to 40 feet above the floor, and standing water is present in portions of the quarry, due in part from groundwater. MWRA had determined that the quarry site is hydrologically linked via surface water drainage, and possibly groundwater through the bedrock fractures, with the adjacent Rumney Marsh. This 1,070-acre salt marsh is located at the confluence of the Pines and Saugus Rivers, and is considered an extremely valuable regional resource, as indicated by its 1988 designation as an Area of Critical Environmental Concern.

Converting Rowes Quarry to a lined landfill for BHNIP silts would require compliance with Massachusetts Department of Environmental Protection (DEP) regulations for siting and constructing a solid waste landfill (310 CMR 19.000). Several unconventional engineering techniques would be necessary to overcome the construction constraints imposed by the bedrock fractures, exposed bedrock, high groundwater, and vertical quarry walls. NEI (1989) calculated that 356,000 cubic yards of fill would be required to prepare the quarry prior to liner installation. Because no soils exist on the site, the entire fill quantity would need to be transported to the quarry in an estimated 17,800 truckloads. Assuming the constructed landfill would be 30 acres in size on the 43-acre site, the silt capacity is estimated to be 484,000 cubic yards (or 24,200 truckloads). Therefore, constructing the site would require importing three-quarters the amount of material the landfill would eventually accommodate.

A portion of the estimated 356,000 cubic yards of fill required to prepare the quarry floor for a landfill could potentially be obtained from the BHNIP parent material. Some mixing with clean material will be required to reduce the chloride concentrations in the BHNIP material to acceptable levels for terrestrial use. Chloride concentrations in the berth parent material averages 1.8% (BHNIP DEIR/S, Volume 2, Appendix C-3), which converts to approximately 8,000 - 18,000 μmhos/cm conductivity. The Bureau of Waste Prevention Policy 94-037 currently sets a maximum allowable conductivity of 4,000 μmhos/cm. A dredge material disposal policy currently under development is likely to set an even stricter threshold (Joel Hartman, MA Division of Solid Waste, personal communication). The amount of mixing, and thus the quantity of BHNIP material that can be beneficially used as part of the fill material will need to be more fully addressed should this site ever be used for marine material disposal.

B. Environmental

Rowes Quarry's proximity to the Rumney Marshes ACEC will probably require

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2 NEI. 1989. An independent assessment of the selection process for MWRA residuals landfill in the greater Boston area. Normandeau Engineers, Inc., Concord, NH. Prepared for the City of Revere, MA 24 pp + App.

extensive studies of the marsh and estuary in order to determine the risk to the ACEC from the landfill should the liner or leachate collection system fail. These studies are likely to include calculations of the probability and frequency of several design failure scenarios, estimates of both acute and chronic levels of contamination, and the probable fate of contaminants in the ACEC, as well as hydrologic testing and modeling to understand the ground and surface water connections between the site and the ACEC. The time and costs required to complete these studies and the difficulty of designing, building, and permitting a secured disposal facility makes the option prohibitive.

C. Social/Economic

The high densities of residences and sensitive receptors (including several schools and a nursing home) in the immediate vicinity of Rowes Quarry are also a strong deterrent against the use of this site. NEI (1989) reported over 12,000 residences within 1 mile and 2,500 within one-half mile. In the 7 years since the report, the population numbers have likely increased due to the high development pressures in the surrounding communities of Malden and Revere.

The quarry owner has consistently rejected any discussion of selling Rowes Quarry, which would require BHNIP to take this site by eminent domain. This approach is objectionable to the Project team because of both the loss of a thriving business and the associated jobs, and the length, and expense of the eminent domain process. The cost to buy the property is estimated to be 5 to 14 times higher than the other possible sites.

D. Permitting

The permitting process for Rowes Quarry will likely be disproportionally long and complex compared to most other sites on the current disposal options list. This is due primarily to: 1) its proximity to Rumney Marshes ACEC; 2) its location straddling the Malden/Revere corporate boundary, which would necessitate permitting in both towns, and; 3) the surrounding high-density residential population which voiced opposition to the use of the quarry by MWRA because of nuisance issues and the likelihood of a decline in property values. Additionally, as described above, obtaining the property by eminent domain could result in lengthy court proceedings. Some or all of these permitting obstacles would result in delaying the BHNIP well into the future.

E. Future Maintenance

In light of Rowes Quarry's current siting limitations, this site may be a more reasonable disposal option for future maintenance dredging material because several major obstacles may be eliminated or reduced in magnitude over time. The owner of the quarry stated in 1989 that the quarry resources will be exhausted within the next several decades (NEI 1989). At that point, the quarry operation will cease and the owner may be more amenable to selling, which would eliminate two BHNIP concerns of interrupting an active business and taking the property by eminent domain. Also, technological advances may improve the dewatering techniques currently available, which will make all land-based disposal options more available in terms of both environmental impacts and costs. In such a case, Rowes Quarry

may be an advantageous disposal site because of the quarry's proximity to Boston Harbor. Finally, designation of the site for future maintenance disposal would allow sufficient time to complete the anticipated lengthy permitting process well in advance of the need for the site.

3.1.2.3 Phase III Site Screening

Phase III involved the development of additional site-specific information for the short-listed sites through site visits, aerial photographs, and discussion with appropriate resource agencies. The short-listed sites were re-evaluated against the Phase II criteria in light of the additional information resulting in a revised short-list (see Table 3-1).

3.1.2.4 Phase IV Site Screening

In response to comments received during the DEIR/S public comment period, two areas of additional information were identified that would benefit the site selection process. These included: 1) water resources at the land-based inland sites; and 2) biological conditions at the aquatic sites, excluding MBDS. The following sections discuss the additional data acquisition efforts undertaken by the project partners to further screen the short-listed sites remaining after the Phase III screening.

A. Review of Phase II Evaluative Criteria for Land-based Inland Sites

Additional information was collected to review selected Phase II Evaluative Criteria for Land-based Inland Sites. Information was obtained from Massachusetts DEP representatives regarding public water supplies. A Normandeau representative also visited the DEP Northeast regional office to review the DEP Water Supply Protection Atlas and the Bureau of Waste Site Cleanup (BWSC) Resource Maps. Individual BWSC Resource Maps were obtained for all fourteen Land-based Inland Sites.

Normandeau obtained information on public water supplies from the DEP regional offices. Mr. J. Otavio Paula-Santos of the DEP, Division of Water Supply in Boston provided Normandeau with the "List of Public Water Supplies and Their Sources" for DEP Northeast Region. Mr. Larry Dane (DEP Southeast Regional Office in Lakeville, MA) provided a listing of towns in the DEP southeast region which have surface water supplies and their surface water sources. Mr. Dave Erickson (DEP Northeast Regional office in Woburn, MA) informed Normandeau that the Massachusetts Water Resource Authority (MWRA) supplies water to most of the Boston Metropolitan area. The second largest water supply source is the Merrimac River upstream of the Lawrence Dam. Additional surface water supplies include the Hobbs Brook/Stony Brook Reservoirs along Route 128 and also the Concord River.

A Normandeau representative visited the DEP Northeast Regional office in Woburn, MA on December 9, 1994. The purpose of this visit was to review the DEP Water Supply Protection Atlas and the DEP, BWSC Resource Maps relative to the Phase II Evaluative Criteria concerning surface water and groundwater resources. Information that was collected from the regional offices was used to re-evaluate

certain screening criteria and to evaluate those criteria which were previously listed as "undetermined" (see Appendix E, DEIR/S), meaning that information for a particular site was not available. The re-evaluating confirmed the screening of the 14 inland sites. The only change occurred at the Wrentham site (W-495). The DEP, BWSC Resource Maps show that the W-495 is located within a DEP Zone II Wellhead Protection Area.

B. Additional Sampling in Marine/Coastal Habitats Since Draft EIR/S

Additional sampling at nearshore aquatic and marine sites was conducted in October 1994 (see Appendix E). The sampling plan was reviewed by Federal and State resource agencies and modified in response to agency comments. The purpose of the sampling was to add an additional data point to the body of information already existing and used in the DEIR/S and to confirm or refute the earlier findings. Nineteen locations in Boston Harbor and three locations on Massachusetts Bay were surveyed using a sediment profile imaging (SPI) camera. Samples were collected for benthic infauna at each location using a 0.04 m^2 Van Veen grab. The dredging and disposal sites surveyed in this study are shown in Table 3-2.

A finfish resource evaluation was conducted in October and November 1994 (see Appendix E). Demersal fishes were collected using a nine-foot otter trawl with a 0.64 cm cod end mesh at the six stations shown in Table 3-2. Three trawls, lasting either 5 or 20 minutes (depending on conditions) were made at each location. Gill nets were utilized to collect demersal fish at eight stations, including the four dredge or disposal sites listed in Table 3-2. Scientific gill nets measuring 30.3 m x 3.03 m with varying mesh sizes were set a surface and bottom depths for a total of 72 hours, and were fished at a 24 and 48 hour interval.

Lobster resources were assessed through a trapping program (see Appendix E). Modified lobster traps (escape vent closed) were set at three offshore, one outer harbor, and nine inner harbor locations. These included the dredge and disposal sites listed on Table 3-2. Traps were harvested every twenty-four hours for a three-day period in October 1994. Lobsters were measured, sexed, and enumerated.

The results of these sampling events are fully discussed in Chapter Four of the FEIR/S and were factored into the environmental assessment of each potential aquatic disposal site. The sampling reports fish, benthic, and lobster resources are included as Appendix E (see Volume 3). The findings of the October 1994 sampling confirm the earlier data gathered in sampling programs conducted in July and November 1986 and April 1993, as summarized in the DEIR/S.

3.2 SEDIMENT/SITE MATCHING

As stated in the original MEPA scope and the 1988 Feasibility Report, ocean disposal (Massachusetts Bay Disposal Site) is the preferred disposal option for uncontaminated marine sediments of acceptable quality and is the option against which other alternatives were originally evaluated. However, a substantial component of this project has focussed on the issue of quantifying the levels of metals and organics in project sediments. Review

of these results has indicated a wide range of chemical concentrations in sediments throughout the project area (Section 2.2 and Appendix C of the DEIR/S). Characterization of sediments for disposal options relies on interpretation of the results of bioassessment in terms of ecological significance, and is, therefore, not a clearcut decision. The Corps has joint responsibility for making this determination. The EPA has veto authorization The silt from the Reserved Channel area was the only material for which a consistent opinion was not reached. However, based on public and agency comments on the DEIR/S, and to ensure that the disposal option alternatives analysis would identify sufficient space, it has been concluded that alternatives to unconfined ocean disposal would have to be sought for all silt materials from the project.

Potential impacts arising from disposal of the silt vary among the generic alternatives. These differences are reflected in testing requirements and required control measures (Table 3-3). All disposal types evaluated require bulk chemical analysis of most parameters identified in the "Green Book" (EPA/ACOE, 1991). Unconfined open water disposal and lined and unlined landfills, each have identified thresholds for a suite of parameters that must be met for disposal to be permitted (Table 3-4). Thresholds for non-landfill upland disposal are not currently established; however, site suitability was evaluated assuming that such a facility would be lined and that the Category A (lined) landfill criteria would be appropriate.

Similarly, regulatory thresholds for in-harbor or coastal containment have not been defined. Both alternatives would provide isolation of the disposed material from the surrounding environment once disposal is complete. The in-harbor containment alternative provides the opportunity for isolation during disposal. It was assumed that there were no sediment quality thresholds necessary for in-harbor containment or open-water containment, but that either alternative would be dependent on achieving acceptable water quality conditions as demonstrated by acceptable water quality modeling results or monitoring. Stability of the disposed material after emplacement on the bottom would also have to be addressed.

In response to agency and public comments received on the DEIR/S, and to address these latter issues of water quality impacts and sediment stability, the project team performed extensive studies in preparation of this FEIR/S. The first was a series of models to determine the transport and fate of silt disposal at the aquatic short-listed sites. The results of these models are used in Chapter 4 in evaluating impacts among the short-listed sites. The complete water quality modeling report appears as Appendix F in Volume 3 of the FEIR/S.

The second series of studies included a characterization of near bottom water velocities generated by typical vessel operations in the improved Boston Harbor. This study, and other studies on sediment stability, are included in Appendix G in Volume 3 of the FEIR/S. This information is used in evaluating the need for armoring and stabilizing sediments disposed under aquatic conditions in the Inner and Outer Harbor.

In sum, site-specific sediment data were compared to thresholds for each disposal alternative (Table 3-5). Clay and rock from all dredging areas were acceptable for any type of disposal, provided capacity was available. The following section discusses how silt material could be managed for each of the generic disposal options, including special handling or design features required for disposal, with the least environmental impact.

3.3 SUITABILITY OF GENERIC TYPES OF DISPOSAL ALTERNATIVES FOR DREDGED SILT

The types of impacts associated with disposal of dredged materials can be categorized generally as habitat loss or alteration, water quality degradation, emigration (physically or biologically) of contaminants from the disposal site, and socioeconomic concerns (primarily fishing, land use and traffic) and are related to site preparation and management activities. The following paragraphs summarize the site preparation and management requirements needed for each generic disposal alternative to minimize these impacts. The findings are summarized on Table 3-6.

3.3.1 Land-Based Alternatives

A. Inland and Coastal Sites

In general, upland sites would have to be cleared and graded before construction of a silt containment facility. The containment facility would include a liner, diked disposal cells constructed in sequence, runoff and leachate controls, and access roads (Table 3-6). Closure of the site would include capping and landscaping. Configuration of the containment facility would be designed to minimize impacts to critical environmental features.

Locations of upland sites are shown in Figure 3-1. Access to inland sites is restricted to truck or rail transportation. Coastal sites could be accessible by barge, although this could require dredging of access channels.

Potential impacts associated with developing an upland (either inland or coastal) disposal facility are, in contrast to landfills, relatively severe (Table 3-7). While it would be desirable to focus on previously degraded sites, areas that have received other waste materials are not always suitable for disposal facility development without remediation first. While chemically-degraded sites may be suitable for a long-term future regional facility after remediation, sites that have experienced habitat alteration (clearing, excavation and mining) are the most likely candidates available for the BHNIP. Development of a disposal facility on such a site could result in loss and/or alteration of terrestrial habitat (particularly Wrentham (W-495) and Woburn (WOB-11)), possibly including wetlands. Loss of vegetated wetland habitat (Table 3-8) would occur with development of the Wrentham (9 acres), Woburn (1 acre) and Squantum Point (QUI-03) (0.3 acres) sites. Everett (EVR-04), Squantum Point and Wrentham all provide habitat for state-listed species of special concern (Table 3-8).

Development of the coastal sites (Everett and Squantum Point) would affect marine resources due to dredging. Prevention of

water quality impacts would depend on site design features including design criteria to minimize the risk of exposure of freshwater resources to elevated chloride levels (inland sites only) or contaminants. Marine waters could experience locally-elevated turbidity and contaminant concentrations at the dewatering site (Mystic Pier or North Jetty) for inland sites, but this would be limited by proper design and monitoring. Depending on site access, use of coastal sites could affect marine water quality during site preparation (dredging for barge access) or dewatering (for truck transportation). Both inland and coastal sites offer some risk of contaminant emigration due to the prolonged period required for drying the sediments before capping. Although the disposed materials would remain azoic, the containment area would appear pondlike and may be attractive to birds.

Both types of sites could have socio-economic impacts - displacement or alteration of land use and high truck traffic volumes. None of the short-listed sites are currently in use except Woburn which has a closed, but uncontained, municipal landfill onsite. Due to its large capacity, Wrentham would experience the highest truck volume but its proximity to major highways would minimize the neighborhood effects of this traffic. Rail access could become available for Woburn. Barge transport would be likely for Everett and Squantum Point.

Disposal of silty sediments from Boston Harbor in an upland area would remove this associated chemical load from the harbor environment (Table 3-9). A regional facility might be able to use a chemically-degraded area, but the remedial actions necessary to develop such a site would be greater than a single project (even a large one) could bear. Thus, such sites were not short-listed although any upland site that demonstrated merit for potential development would require a preliminary assessment, as a minimum, for hazardous materials. Parent material (clay) could be used in construction of the site, although the silt would then have to be stockpiled during construction. There would be potential for enhancement of terrestrial habitats once the facility was closed. Any landscaping would have to preserve the integrity of the cap, probably eliminating the planting of trees.

B. Landfills

Existing landfills can provide disposal space for marine dredged materials under two scenarios - use for daily cover or burial. In the case of the BHNIP, the surficial silts would have to be mixed with clean materials to meet the regulatory thresholds for daily cover.

No special site modifications would be required for landfills, although all the short-listed landfills have odor limitations. Three existing landfills (Figure 3-1), Plainville/Laidlaw, East Bridgewater and Fitchburg/Westminister, were identified as having the ability to accept marine sediments in the approximate time frame for the BHNIP.

From a qualitative perspective, use of lined landfills for disposal of dredged materials provides the least environmentally damaging alternative (Table 3-8) because the natural environment has already been disturbed to develop the landfill. However, competition for space at landfills is a key issue. Landfill space is fast

approaching capacity, and while various landfills are capable of handling marine sediments, this type of use could displace other, higher-priority uses. Of the 122 landfills currently permitted to accept municipal solid waste in Massachusetts, 114 are scheduled for closure by 1996 (DEP, January 1993 active MSW landfill list). The three sites short-listed have limited capacity for burial of dredged material (Table 3-8). The exception is that there continues to be a need for daily cover and final closure material. Dredged material can be suitable for these purposes under some circumstances. To be used for daily cover, sediment must have contaminant levels within a range that, after mixing with a "reasonable" amount of clean material, would meet TCLP regulatory levels (Table 3-4). Maximum need for daily cover that could be provided by BHNIP dredged materials ranges from 50 cy/day (Plainville/ Laidlaw) to 250 cy/day (Fitchburg/Westminister) (Table 3-8). Only clean material that would contribute to construction of an impermeable layer could be used for a cap. Marine clay can be suitable for this purpose (S. Lipman, MADEP, 1993, pers. comm.). The limited available capacity for dredged materials at these landfills would minimize the traffic burden associated with the BHNIP.

The benefits (Table 3-9) of using landfills for disposal of marine sediments are relatively high, primarily because this alternative utilizes existing facilities. Again, however, this apparent benefit must be weighed against the constraint of competing uses for a limited resource.

3.3.2 Aquatic Alternatives

A. Shoreline Facilities

There are two fill alternatives proposed for the Mystic Pier sites, Revere Sugar, Amstar and Cabot Paint (see site locations Figure 3-1). The first alternative is for partial fill which would result in a final elevation (including cap) of mean low water. The total fill alternative elevation would be mean high water (or higher where adjacent land elevations would allow it). For both alternatives, a bulkhead would be constructed to isolate the site from the harbor during disposal. The bulkhead would remain in place after disposal in the total fill alternative but be cut off at MLW after the cap was secured for the partial fill alternative.

Two fill alternatives were considered for these sites since the cost of disposal site development can only be offset by maximizing the disposal site capacity. However, the total fill option creates an irretrievable loss of subtidal habitat by replacing it with fast land. The partial fill option is designed to allow for the establishment of intertidal habitat.

Little Mystic Channel and Reserved Channel (Figure 3-1) would require maintenance of aquatic habitat. Little Mystic Channel would be filled to a final elevation (including cap) of -6 to -3 ft MLW. Fill in the Reserved Channel would encompass either the entire area west of Summer Street or only the western end of that area. The western end would, in either case, be filled to a final grade (including cap) of +9 ft MLW, a suitable elevation for establishing salt marsh vegetation. The eastern portion would be filled to a final elevation of -6 ft MLW.

Both sites would be bulkheaded during disposal.

Both shoreline fill scenarios would result in loss of marine habitat, although in the partial fill scenario loss would be temporary (Table 3-7). Permanent habitat losses would be highest at Cabot Paint (total fill). Temporary habitat losses would be highest at Reserved Channel (if entire area used) or Little Mystic Channel (Table 3-10). There were no marked differences in benthic infauna among the six potential disposal sites, but the pier areas (Amstar, Cabot Paint, Mystic Piers and Revere Sugar) may provide slightly better finfish refuge potential than the channels (Little Mystic, Reserved) because of the pilings. Ultimately, in the partial fill alternative, marine habitat could be altered from fine-grained substrate to vegetated or rocky substrate of potentially higher productivity (Reserved Channel, Little Mystic Channel).

Temporary localized water quality impacts could be minimized by appropriate site management (e g., dredging and disposal methodology, disposal behind bulkheads, use of silt curtains, disposal timing) for both total and partial fill alternatives. In both scenarios, the disposal site would be essentially isolated from the rest of the harbor. The partial fill scenario could pose a slightly higher risk of emigration of silty sediments in the long term than the total fill. Since the short-listed shoreline sites are in relatively quiescent parts of the harbor, and thus relatively safe from erosional currents, other forces (e.g.; boats, biological activity) are unlikely to disrupt the cap of the partial fill.

Land use impacts would be site dependent. Any fastlands created would have to be used for a water-dependent activity. Alterations in current use would be greatest at Amstar because of MWRA's newly constructed floating dock (for transport of Deer Island workers). Other pier areas are not presently in use. Filling in the eastern portion of Reserved Channel could interfere with the existing marina operations. Traffic impacts would be minimal at pier sites since sediments would be transported by barge. It could be necessary to use a barge and truck combination for Little Mystic Channel and Reserved Channel because of low clearance bridges across the entrance of each site.

Each of these fill alternatives could result in environmental or socioeconomic benefits (Table 3-9). All of the shoreline sites are likely to have or have been demonstrated currently to contain, contaminated sediments with elevated chemical constituents. Either the total or partial fill alternative would isolate these contaminants from the Boston Harbor environment. The partial fill scenario has the potential to enhance the environmental quality of the site by providing clean substrate for benthic organisms (all sites), or plantings to increase primary productivity (especially Reserved Channel and Little Mystic Channel). Totally filled sites could be developed for port-related activities. Clay from the improvement dredging could be used in capping these sites, reducing the need to transport material to MBDS.

C. Subaqueous Depressions

Use of the outer harbor subaqueous sites B and E (Figure 3-1) would rely on existing bathymetric conditions to keep disposed

sediments in place. Sediments would be transported by bottom-dumping scow. After disposal of silt is complete, the area would be capped by depositing granular material over the sediments.

Use of the subaqueous depressions would result in temporary habitat losses until capping was complete (Table 3-7). The disposal site footprint would be smallest at the Winthrop Harbor site (8 acres). Subtidal habitat would be altered by changes in substrate texture and depth. Some fine-grained sediments and associated contaminants would remain in suspension and be transported away from the disposal site. ADDAM'S model results indicate that the plume could extend a distance of approximately 4,500 ft from the disposal site and on a flood tide potentially carry contaminants (which may exceed water quality criteria by 2x) outside the disposal site.

Commercially harvested clam beds on the Snake Island flats and the Basin could be sensitive to sediments with elevated contaminants dispersed from a Winthrop Harbor disposal site. Disposed sediments would be exposed to currents for the duration of disposal activities, presenting a risk for further emigration and bioaccumulation.

The model results imply that water quality exceedences should not extend up-channel beyond Chelsea Point in Winthrop, so the Belle Isle Main ACEC should not be at risk (Table 3-11). Subaqueous B and E are exposed to higher current velocities than Winthrop Harbor but water modeling showed no impacts to areas of potential exposure including the Governor's Island flats and Deer Island flats. There would be no land-based traffic impacts to any of these sites, although some impacts to navigation would occur. Restrictions would be temporary in Winthrop Harbor and Subaqueous B. Seasonal recreational boating could restrict disposal operations in Winthrop Harbor. Small boat use of the channel passing across Subaqueous E could also cause seasonal restrictions on use of the site.

Using subaqueous depressions for material disposal would isolate dredged contaminants from the harbor ecosystem. Another benefit associated with the subaqueous disposal alternatives is the ability to use project parent material for the cap (Table 3-9).

D. In-Channels and Borrow Pits

Both In-Channel and Borrow Pit alternatives would require additional dredging of *in-situ* parent material. Sufficient surficial material dredged from the borrow pit areas would be stockpiled to use as final capping material to restore the site to pre-existing substrate conditions. Native clay from channel deepening could be used for the initial cap at borrow pits. Sand, from either the parent material or bought, would be used to cap the in-channel areas due to the tolerances that have to be achieved in the final bathymetry in the navigation channels.

In-Channel alternatives would include Chelsea Creek, Inner Confluence and Mystic River navigational channels. Borrow pit alternatives include Meisburger 2 and 7, and Spectacle Island CAD (see Figure 3-1). This latter site is located in the shallow (-10' MLW) subtidal area east of the Island and is totally disassociated

from the Island itself and the CA/T project work in progress.

Both the In-Channel and the borrow pit alternatives would temporarily remove marine subtidal habitat from production. There would be a greater impact at the previously undisturbed Meisburger sites than the In-Channel alternatives. Surface substrates at borrow pit sites could be altered somewhat but substrate in the In-Channel sites would not be noticeably different from the planned post-dredging conditions.

Containment of sediments during disposal for inshore alternatives is an issue requiring mitigation to lessen the resulting turbidity plume. ADDAM'S model results indicate that water quality criteria exceedences would not occur at the offshore (Meisburger) or Spectacle Island CAD site. Sediments would be exposed for the duration of the disposal operation, resulting in some potential for emigration through current transport or biological activity. The smaller capacities of the In-Channel alternatives would result in shorter periods of exposure than the borrow pits. However, ADDAM's model results, for the Subaqueous E site, indicate that there could be water quality criteria exceedences during flood tide after four hours; and silt/clay plumes were predicted to extend as much as 4,500 ft upstream of this in-harbor disposal site. Because of shallower water near the Spectacle Island CAD site, dilution to below water quality criteria was predicted at greater distances, but reached that distribution level in less than four hours.

Biological impacts could vary among the In-Channel alternatives primarily because of the Mystic River's value to anadromous fish although seasonal restrictions on disposal in the Mystic River Channel could avoid these impacts. The offshore borrow pit sites, Meisburger 2 and 7, support high benthic productivity and fisheries resources are relatively abundant. The outer harbor Spectacle Island CAD appears to support substantially lower benthic production. Its location in the general vicinity of the proposed Central Artery/Tunnel fish reef mitigation and beach project, however, would mean that disposal methods and/or mitigation efforts would need to account for the protection to this resource if it is in place by the time the Harbor is dredged. Additionally, special plans to avoid or mitigate for fishing gear losses (lobster, pots, etc.) from barge traffic or construction activities may be necessary at the Meisburger and Spectacle Island sites.

The In-Channel alternative would use suitable granular material (sand and gravel) as a capping material due to the tight tolerances needed in the in-channel option and the ability to reduce voids in the cap by using sand rather than cohesive clay. Clay could be incorporated into the borrow pit cap. Sediments (sand and gravel) dredged from the borrow pit sites during site preparation could be used for beach nourishment or construction, if the need exists. Otherwise, this sediment would have to be disposed at MBDS. The In-Channel alternative has the advantage of being located in an already impacted area (i.e., the navigational channels).

E. Existing Disposal Sites

Previously-used dredged material disposal sites, MBDS and Boston Lightship (Figure 3-1), could be utilized for the project for silt disposal, with capping. At MBDS

disposal of contaminated material with capping is prohibited unless a successful demonstration is made; with respect to the BLDS, the Corps has successfully demonstrated effective capping at sites with similar depths elsewhere in New England. A containment area would be prepared by configuring parent material in a specific area. Silt would be point-deposited by accurate positioning of the barge. Once disposal was complete, additional granular material would be deposited over the silt to form the final cap.

Disposal of silty dredged materials at a previously-used disposal site would have impacts generally similar to use of a borrow pit (Table 3-7). Since disposal of the silty sediments at the Massachusetts Bay Disposal Site is currently prohibited by EPA without further testing, a field program to demonstrate the effectiveness of capping moves this site out of a reasonable time frame for use on the current project. Agency concerns associated with capped disposal at MBDS have largely focussed on emigration of contaminants/sediments during disposal and long-term integrity of the cap. In a recent study by EPA (1993) ADDAM'S models were run for the MBDS using this project's data and no water quality exceedences were predicted outside the site during the disposal phase (Table 3-12). These results were used to conclude that disposal activities from this project (BHNIP) would not add to impacts from the MWRA ocean outfall at a level to cause a risk to threatened and endangered species in the area. ADDAM'S model results for the Boston Lightship also indicate that water quality criteria would not be exceeded outside that disposal site which is half as deep and twice as close to Boston as MBDS. In the foreseeable future BHNIP is the only project that could provide its own capping material, perhaps representing the only opportunity to cap silty sediments of this volume and provide a demonstration of this option's effectiveness. This scenario would provide beneficial use of all parent material dredged from the project. Capping at the MBDS may represent a practicable alternative for the future maintenance material as it is not considered implementable at this time due to the EPA and CZM requirement for a demonstration of its efficacy. The ability of the Corps to perform a capping demonstration would hinge, in part, on the availability of suitable material.

3.4 DEVELOPMENT OF DISPOSAL OPTIONS

As discussed previously, there are few alternative disposal sites that have the capacity to handle all the dredged material, parent, silt and rock, for this project. In addition, disposal considerations must include the requirement of future disposal of maintenance (silt) material. In order to address both the present and future capacity needs individual disposal sites have been combined into disposal options which attempt to balance environmental consequences with practicability concerns.

The volume of material requiring disposal from the proposed BHNIP was conservatively estimated to ensure sufficient capacity will be provided at disposal options. Table 2-1 presented the estimated volumes of rock, parent and silt material requiring disposal. The volumes shown assume up to a 0.5 foot of parent material is also dredged to ensure all silt

material is removed. The volumes also factor in a 20% expansion of silt and parent material over in-situ volumes to account for the water entrained in the dredging process. Rock was assumed to expand by 50% over in-situ conditions due to the blasting fractures. Based on the measured in-situ volumes and expansion factors the BHNIP will generate approximately 132,000 cy of rock, 2 million cy of parent material and 1.3 million cy of silt. These quantities represent one consideration used in developing potential disposal options. As discussed in Section 3.2 and summarized on Table 3-5, sediment quality must also be taken into account in considering disposal sites. Environmental impacts of using undeveloped sites for disposal, presented in Section 3.3, are also a factor in developing disposal options, particularly related to contaminated dredged material. Finally, practicability considerations of costs, technology and logistics which are reasonably related to project needs must be factored into the development of disposal options.

These four factors: sediment quality, environmental impact, volume and practicability, were used to formulate several disposal options by combining land-based and aquatic sites. The following sections describe options in four categories developed through the process defined above. Each option assumes that dredged parent material and rock will be used for beneficial uses to the maximum extent possible and that these uses will be identified and expanded throughout the EIR/S process. The remaining quantity of this material after beneficial uses are accomplished will be disposed at the MBDS.

Options for disposal of silt material considered potentially unsuitable for unconfined ocean disposal (Table 3-13) are the primary focus of the next section. Options defined as group "A" include combining land-based sites for silt disposal. The "B" group options focus on combining aquatic sites while "C" group options include combinations of land-based sites and aquatic options. The "D" group options consider aquatic sites previously used for offshore disposal and which have the capacity to receive all the project material.

Tables 3-14 through 3-19 and 3-21 provide the costs of alternative disposal options described in the following paragraphs. The objective of preparing these tables was to determine relative unit costs by estimating the total cost to dredge the silts, process the dredged material, transport the material to the disposal site, construct any required features at the disposal site and any other costs associated with the dredging and disposal of silts. The costs are based on April 1995 price levels.

The unit costs should not be used to estimate a project cost. Project costs, once a disposal site is selected, will be computed based on optimal use of equipment, distribution of silts to other disposal sites if applicable, and other factors that can not be estimated until a final disposal plan is selected and the cost of disposal of the parent material is determined. Also cost for mobilization would have to be added as well as associated design and construction management costs required for the selected plan.

Assumptions used are listed on each table. Existing information was used when available. Experience from other projects

was used when specific site data was unavailable. These assumptions should be carefully reviewed since, in some cases, significant cost items are not included (i.e., real estate acquisition costs for upland and shoreline sites).

3.4.1 Land-Based Options (A)

Use of any of the upland sites for silt disposal would require that the material be dewatered prior to disposal. Dewatering would occur at Boston Harbor shoreline sites to facilitate trucking efficiency and minimize potential chloride impacts to freshwater systems. For calculations of disposal needs it was assumed that dewatering and compaction would reduce the silt volume nearly to its in-situ estimate of approximately 1.1 million cy.

Option A1. Option A1 would involve disposal of all silt at landfills. The three landfills which survived the screening process (see Table 3-1) are expected to have a combined maximum need of 1,000 cy/day of cover material. TCLP results indicated that most of the harbor silts would have to be mixed with equal quantities of clean materials to be suitable for daily cover, reducing the total potential daily use of project material to 500 cy/day, or 7-13% of the anticipated dredging rate. Over the anticipated 100 days of silt dredging (assuming two dredges, yielding 8,000 cy/day each), the total daily cover needs at the landfills of 50,000 cy would fall far short of project disposal needs. In order for landfills to provide the necessary capacity, project sediments would have to be buried, not simply used as daily cover. Using all three landfills, a total of 525 cy/day of silt material, or 52,500 cy over the 100 day dredging period could be buried. The maximum disposal capacity for project silts combining daily cover and burial is, therefore, 102,500 cy.

As pointed out in preceding sections, there are definite environmental advantages to using landfills since they are engineered and permitted designated disposal areas. The major drawbacks to using landfills are daily limitations on quantities that the landfills can handle and competing public uses for landfill capacity. It would take more than 4 years to accommodate the 1.1 million cy generated by the BHNIP using Option A1. Costs would range from $62 - $108/cy to dispose of material at the landfills not including the cost of land needed to stockpile silt for four years (see Table 3-14).

Option A2. Option A2 would involve a combination of one or more landfills and one or more inland sites. Meeting the capacity requirements of the BHNIP would, at a minimum, involve using Wrentham (W-495), Squantum Point (QUI-03), and all three landfills. To reduce the volume of dredged materials to be buried at the landfills (52,500 cy), a third upland site, Everett (EVR-04), would have to be included. Any other combination of inland and landfill sites would fail to provide adequate capacity. Distribution of dredged material to four or five different locations would be difficult logistically and each town would feel the maximum potential effects of disposal. In addition, all dredged material would have to be dewatered. Once dewatering started, dredged materials would have to be removed at the rate of 4,000-8,000 cy/day (200-400 truckloads) while silt was being dredged.

This option also assumes that a lined disposal facility would need to be designed and constructed at two or more inland or coastal sites and that silt overburden in excess of landfill capacity would have to be stored until access to sufficient quantities of clay become available for the facility's liner. Costs for Option A2 would be approximately $63/cy (see Table 3-15).

Option A3. Option A3 would rely entirely on developing land-based disposal sites for the silty material. Individually none of the four upland sites could provide the total capacity needed for the BHNIP, but the combination of the Wrentham (W-495), Woburn (WOB-11) and Squantum Point (QUI-03) sites meet the capacity needs. This option also provides some excess capacity beyond the current project needs. The benefits of Option A3 include reserving landfills for other public uses, minimizing the area and time needed for stockpiling and minimizing impact to the marine environment. Significant drawbacks include long-term management of three sites along with attendant costs, the minor capacity available for future dredging projects and on-site and neighborhood impacts from constructing the facilities and transporting up to 55,000 truckloads of silt to the sites. Costs for implementation of the above scenario of the Wrentham, Woburn and Squantum sites would be $60/cy (see Table 3-15).

3.4.2 Aquatic Options (B)

Aquatic options must be able to accommodate an estimated 1.3 million cy silt material which includes the 20% expansion factor over in-situ volumes.

Option B1. Option B1 relies on placing all the silt material in shoreline containment areas. Use of all the sites short-listed could not provide all the disposal capacity needed for the BHNIP, but use of some or all of the sites could provide a variety of disposal configurations in combination with other types of sites. Filling these sites (Amstar, Cabot Paint, Mystic Piers, Revere Sugar to fastland; Little Mystic Channel to -3 ft MLW; and Reserved Channel to MHW in its western end and -6 ft MLW near the Summer St. bridge) would result in a temporary or permanent loss of marine habitat. However, this option would benefit the Boston Harbor aquatic environment by covering the silty sediments that presently exist at these sites, would enhance sediment quality for benthic organisms and could enhance primary productivity by creation of low salt marsh in Reserved Channel or subtidal productivity in parts of the Little Mystic Channel. Impacts to harbor traffic are also minimized by providing disposal within the vicinity of the proposed dredging. This option would not have capacity remaining for future use unless an additional site were included in the development plans.

Costs for maximum capacity at all six sites range from $7 - $362 cy depending upon the amount of engineering and site preparation required (Table 3-16). Costs include construction of a bulkhead across the face of each site and transfer of sediments from barge to truck by crane.

Option B2. Option B2 involves filling existing outer harbor subaqueous sites. No site by itself would provide the capacity necessary for the BHNIP. Combination of the maximum fill scenarios at Subaqueous B and Subaqueous E and Winthrop Harbor would provide sufficient project capacity. Because development of the subaqueous sites would not include construction of a physical containment structure, future use (if any capacity remained) would be dependent on having sufficient capping material. This option would result in temporary water quality impacts, and loss of marine subtidal habitat during the disposal and capping process. The habitat would be altered in depth, microtopography, and potentially, sediment grain size characteristics. The logistical benefits to this option are substantial as it would mean disposal sites would be near the dredge sites, minimizing conflicts with ship traffic and greatly reducing transportation costs and impacts.

Costs for this option would be approximately $20 per cubic yard (see Table 3-17). No site preparation costs would be incurred.

Option B3. Option B3 would require overdredging in at least three navigational channel areas, creating cells beneath the authorized channel, filling the dredged cells with silt and capping it with sand. Because this scenario would be confined to the footprint of the federal portion of the BHNIP, no additional habitat would be impacted. This option would prolong the dredging process by 3-6 months and require temporary barge storage of dredged silt until the initial cell was dredged. The three channel areas where it would be feasible to overdredge, Mystic, Chelsea and Inner Confluence, would be able to provide the capacity needed for BHNIP. Parent material would have to be disposed elsewhere (probably MBDS) or put to some beneficial use. Overdredging would be impractical in the Reserved Channel because it is the only tributary of Boston Harbor that has no physical restrictions to future deepening. The ability to localize any impacts makes this an attractive option for the BHNIP, it would also offer a potential solution to hold aside capacity for future maintenance dredging. Again, transportation disturbances and costs would be minimized by this option.

This option would cost approximately $30 per cy (see Table 3-18).

Option B4. Option B4 would require dredging and capping a borrow pit for containment of BHNIP silts. A beneficial use would be sought for the material dredged from the pit. Meisburger 7 could provide capacity for all the silt dredged during the BHNIP. Meisburger 2 also has the capacity if the sand and gravel deposits are proved to average more than 10 feet thick. The Spectacle Island CAD with a 45-acre footprint could also provide the necessary capacity. Each of these sites could be constructed to provide capacity for other projects if they occur during the time frame of the BHNIP. The Meisburger sites could provide sufficient additional capacity for future maintenance dredging of Boston Harbor, assuming disposal was confined to discrete cells.

Impacts associated with this option would be temporary but would include disturbance to areas utilized by commercial fish and fishing activities. In-harbor sites

may experience some water quality exceedences while the offshore sites would not. Costs would range between $21 and $33 per cy, depending on the site selected (see Table 3-19). Reuse of sediment dredged at the disposal site could reduce the costs.

Option B5. Option B5 assumes a combination of aquatic shoreline sites and any of the other aquatic sites. This option would require use of at least two sites - an aquatic shoreline site and a subaqueous, in-channel or borrow pit site. An advantage over Option B1 would be the avoidance or minimization of permanent habitat loss, depending on the aquatic shoreline site selected. For example, this option could provide the capacity needed for the BHNIP by filling Revere Sugar to fastland and constructing an intermediate footprint at the Spectacle Island CAD. Any aquatic shoreline site could similarly be combined with the Spectacle Island CAD or with reduced disposal scenarios at the Meisburger sites to meet project capacity needs. Other possible combinations within this option would require the use of four or more sites (e.g. Little Mystic Channel, Subaqueous E, Inner Confluence In-Channel and Mystic River In-channel). Any sites not used could potentially be available for future disposal of Boston Harbor dredged materials.

3.4.3 Land-Based Aquatic Combinations (C)

Option C1. Option C1 would utilize a combination of landfills and aquatic shoreline sites. The combination of all six shoreline sites (to full capacity) and three landfills (50,000 cy of daily cover plus burial of 52,500 cy) would provide disposal capacity for a total of 1.18 million cubic yards. This option does not provide any future maintenance disposal and is logistically quite complex in terms of requiring dewatering locations, barge and truck loading at various sites around the dredging location and increased truck traffic in shoreline and landfill communities. In addition the option removes landfill capacity from other public users. The costs for this option range from $37 to $362/cy depending upon the site.

Option C2. Option C2 would combine non-landfill upland and aquatic shoreline sites. It could be implemented by using as few as three sites; a combination of Wrentham (W-495) and Everett (EVR-04) with Reserved Channel or Little Mystic Channel (to -6 ft MLW). That option would yield excess capacity. Alternatively, Squantum Point (QUI-03), Wrentham, and Mystic Piers (at maximum capacities) would meet needs but provide very little excess capacity. The costs for these scenarios would range between $30 and $76/cy depending on the site selected.

Not using Wrentham would require a minimum of eight sites: Squantum Point, Everett and the six aquatic shoreline sites except Little Mystic Channel, to their maximum capacities. Truck traffic impacts would be reduced in this scenario but construction of shoreline facilities would keep the cost range high, between $37 and $362 depending on the site.

Option C3. Option C3 would utilize a combination of landfills and aquatic disposal sites. Use of any of the borrow pits to full capacity would make landfill disposal essentially superfluous; however, landfills could be used in part if there were

strong public pressure for landfill use. Without the landfills, this option becomes similar to Options B4 or B5, discussed earlier. The Spectacle Island CAD, Meisburger 2 or Meisburger 7 (borrow pits) could provide the 1.3 million cy capacity and would be the simplest way to minimize use of landfill space and completely confine the dredged materials. No habitat would be permanently lost although capping the aquatic site would likely result in some alteration of substrate character. Spectacle Island CAD is located in shallow enough water to enable use of control structures to isolate the site during disposal. At other sites, because no physical structure other than lateral constraints provided by bathymetric conditions (existing or created) would be in place during disposal, some emigration of sediments and contaminants might occur from the aquatic disposal site during placement, potentially affecting nearby fisheries and other aquatic resources. If borrow pits were not used for this option, a minimum of two subaqueous depressions would be required.

Since no structures would be needed, costs for disposal under Option C3 would be less than C1 or C2. Assuming use of Spectacle Island CAD and East Bridgewater landfill, Option C3 costs range from $21 to $62/cy.

Option C4. Option C4 would combine development of a new land-based disposal facility with a non-shoreline aquatic site. Many possible combinations of two or three sites could meet current needs and potentially provide excess capacity for future dredging. Most efficient implementation of this option would likely focus on aquatic disposal first; development of the upland facility would start when clay dredged from the improvement portion of the BHNIP could be provided for the liner of the upland facility. The selection of both the upland and aquatic sites would determine whether excess capacity would remain for future dredged material disposal. Presumably, any excess capacity would be provided at the upland site, provoking the question of costs and responsibility for long-term management of the facility. Possible combinations of sites include Wrentham (W-495) and Subaqueous E; Wrentham, Everett (EVR-04), and Mystic River; and Squantum Point (QUI-03), Woburn (WOB-11), Subaqueous E, Mystic River and Inner Confluence.

Providing a constructed facility with substantial excess capacity would drive the costs of the BHNIP up substantially and would render this option impracticable. A regional use facility could be constructed and maintained by a separate authority. Costs for the suggested combinations of sites would range from $19 to $76 per cy, assuming that upland site preparation costs would be offset by future users of the excess capacity provided.

3.4.4 Previously Used Aquatic Disposal Sites

Option D1. Option D1 would rely on solidification of silty sediments prior to disposal at either MBDS or Boston Lightship. Solidification processes have been demonstrated to stabilize metals, PAHs and PCBs (Breslin, et al. 1988; IWT Co. 1993, pers. comm.) and have been considered to provide permanent removal of these contaminants from the ecosystem when applied in the terrestrial environment (see Section 3.5 and Table 3-20). There would be no short-term water

quality impacts associated with offshore options, as demonstrated by the ADDAM'S model results. This option would also address concerns about resuspension and/or transport of silt sediments offsite, as well as further reducing on-site risks. However, this option would require special handling of the dredged material, and this, along with the cost of the treatment material, would make this option more costly. Disposal of solidified material at an offshore site could increase habitat complexity or make habitat reestablishment more difficult.

Costs for solidification with offshore disposal would be approximately $90 per cy (see Table 3-20).

Option D2. Option D2 would rely on disposal of the silty sediments at either MBDS or Boston Lightship and subsequent capping with parent material (primarily clay) from the channel deepening. As discussed in prior sections, resuspension of contaminants during disposal and from the boundaries of the designated disposal site has been the major concern associated with the capping option. However, modeling done in this study and by the EPA indicates that short-term water quality criteria exceedences should not be a problem with these sites. This project overcomes a major stumbling block faced in the past by proposals for capping at MBDS: availability (or lack thereof) of suitable capping material. The BHNIP will produce over 2 million cy of parent material, 1.5 times the quantity of silt to be dredged. Further, due to the physical constraints created by the transportation tunnels under the Main Ship Channel, it is likely that the Inner Confluence, Mystic Channel and Chelsea Channel will never be deepened below the authorized 40 feet. Thus, the supply of potential capping material is unlikely to be available for this purpose again without relying on an outside source. However, in its final site designation, EPA has found that disposal-and-capping (of unsuitable material) is prohibited at MBDS until its efficacy can be effectively demonstrated (40 CFR 228.12 as amended).

Cost for this option would be approximately $13 to $27 per cy for disposal of project silt (see Table 3-21).

3.5 ALTERNATIVE TECHNOLOGY ASSESSMENT

The silt portion of material to be dredged from Boston Harbor could undergo certain treatment processes that may either immobilize or reduce chemical concentrations to a level that may be acceptable for open water or other disposal options. Various commercial treatment processes exist that have been successfully utilized elsewhere in the country on sediment and on other material that may be applicable to dredged material. In response to interest generated by the DEIR/S in potential treatment technologies, the project team developed a questionnaire survey of technology providers. Section 3.5.1 details the development and results of this survey.

3.5.1 Treatment Technologies

To gather information on technologies available for the treatment of the contaminated dredged materials, the DOWG developed a survey questionnaire. The survey questionnaire was sent to 38 providers of treatment/disposal services. The format of the survey was based upon a

rating system developed by the USEPA for screening treatment options for Superfund sites. This rating method was also used by the Corps and the EPA in the evaluation of treatment and disposal options for the remediation of contaminated sediment in the Great Lakes (Averett et al. 1990.). To evaluate the different treatment technologies, information on the effectiveness, implementability and cost was requested. In addition, the respondent was requested to rank ten factors, from 1 to 10, which affected the estimated cost. A letter was also sent with the survey form to provide background information on the proposed project and to provide a summary of laboratory results on the physical and chemical characteristics of the dredged materials. A copy of the survey questionnaire is included as Appendix D in Volume 3 of the FEIR/S.

Of the 38 survey questionnaires sent, 14 were completed and returned (37 percent response rate). The companies contacted are listed in Table 3-22. The technologies represented by the responding firms included: thermal treatment (7), solvent extraction (2), soil washing (1), biotreatment (1), solidification/stabilization (2), and landfill (1). The questionnaire responses were summarized and are presented in Table 3-23. Of the 14 responses, 13 were further evaluated. The response from Soil Technology was not considered for additional evaluation due to limited development of the technology (laboratory scale).

The following paragraphs summarize each technology category its potential applicability to the BHNIP.

1. Thermal. This category includes incineration processes, pyrolytic processes, vitrification processes, wet air oxidation, and other processes that involve heating the sediment hundreds or thousands of degrees above the ambient temperature. A number of these processes have been widely demonstrated, and are considered effective for destroying organic contaminants. However, they are often more expensive than other options. For example, the low fuel value and high water content of sediments results in high additional energy input requirements during incineration. In addition, volatilized metals and other incineration by-products must be removed from flue gases, ash or other residues for treatment and disposal. Incineration processes may also be difficult to implement because of siting problems related to complex permitting requirements and generally poor community acceptance. On the other hand, few of the non-incineration thermal processes have been demonstrated on other than a bench-scale or pilot basis.

2. Solvent Extraction, Soil Washing and Other Chemical Treatments. These technologies use chemical agents and processes to destroy, modify, remove (extract) or chemically immobilize toxic materials, or to alter them in a way that affects their solubility, stability, separability and other properties affecting handling and disposal. Averett et al. (1990) identifies available chemical treatment processes, including chelation and nucleophilic substitution (dechlorination), as well as 22 extraction technologies, most of which can be viewed as essentially chemical in nature. Variations of these technologies are potentially effective in treating PCBs, non-halogenated semi-volatiles such as PAHs, and metals. However, according to the literature, many chemical processes may be difficult to

implement because of materials handling and process control requirements that have not been fully demonstrated for application to dredged material. Heterogeneity of grain size and density can limit the effectiveness of the extraction processes. For those processes, there may also be problems associated with recovery and disposal of the extraction solvents.

3. Biotreatment. These technologies, which include such processes as aerobic and anaerobic bioreclamation and digestion, treat contaminated sediment through the biodegrading action of microorganisms or enzymes produced by microbes. However, biodegradation is effective only to materials high in organic content, and is generally ineffective for treatment of heavy metals. In addition, biodegradation generally works best under operating conditions which permit a high degree of control of critical process parameters such as temperature, moisture, and nutrient content. These conditions may not be readily achievable for a large volume of material where climatic conditions vary widely or in instances when the treated materials are highly heterogeneous. Furthermore, biodegradation processes are complicated by the possible toxic effects of one contaminant in the treated matrix on the microorganisms used to treat another contaminant.

4. Solidification/Stabilization. These technologies typically isolate and limit mobility of contaminants through solidification and/or stabilization (S/S), and are usually applied to sediments that are ultimately placed in a confined site or disposal area. Averett et al. (1990) cite 12 such processes, including lime-based and Portland cement-based solidification processes, as well as encapsulation. S/S facilitates materials handling, decreases the surface area of the sediment mass across which contaminant loss or transfer can occur, and can limit contaminant solubility through Ph adjustment or sorption phenomena. According to the literature, S/S processes can be effective for both organics and metals. The most common of these technologies have been demonstrated on a pilot or full-scale basis for treatment of soils and solid residues from other treatment processes. In addition, the immobilization processes are generally not as sensitive to process control conditions as the biological and chemical-extractive processes. However, the effectiveness of cement-based solidification processes may be impeded by organics in the treated materials which reduce the binding capacity of the fixative, resulting in premature structural degradation. Another limiting factor in the use of immobilization technologies is the availability of a suitable confined disposal area or beneficial use for the solidified material. Marine applications may be available, however. Artificial reefs constructed of stabilized incinerator residues have been placed in Long Island Sound. Studies on mobility from these reefs of dioxins and furans (Wente and Roethal 1993) and various metals (Breshlin, et al. 1988) have indicated that these constituents have neither leached nor been accumulated by organisms attached to the reef. Other proprietary stabilizing agents have been demonstrated to immobilize PCBs and PAHs (IWT 1993, pers. comm.). Blocks constructed of solidified dredged material may also be useful for shoreline protection and reinforcement.

5. Physical, Mechanical and Landfill Disposal. These are largely dewatering and separation technologies often used to

prepare materials for additional treatment or landfill disposal. Dewatering processes include passive settling and drainage systems, as well as active mechanical systems such as belt filter presses and centrifugation. Mechanical separation and particle classification processes employ equipment such as grizzlies, hydroclones, and hydraulic classifiers to separate fine-grained clays and organic matter from coarser dredged material. This process may be desirable for the Boston Harbor material not only to facilitate handling, but because contaminants tend to sorb primarily onto the finer-grained material, thereby reducing the volume of material which would require treatment. These mechanical technologies are generally widely available, and many have been fully demonstrated in the treatment of sludges as well as in mining and other materials-handling industries. Factors limiting the effectiveness of these technologies can include the moisture content, flow rates, particle size distribution of the subject materials, and practicability of handling the large volumes and high daily production (dredging) rates. In addition, debris typically found in the harbor would have to be carefully removed prior to processing.

Many of the specific processes which fall within each of the technology categories identified above have been reviewed in published literature, either generically or in connection with specific dredging or sediment remediation projects. From this review it was apparent that different investigators have used varying approaches to process nomenclature and categorization of specific processes (e.g., some reviewers classify chelation as a chemical process, others as a physical process; some place extraction within the chemical treatment category, others regard extractive processes as a treatment category by itself.) Averett et. al. (1990) have organized over 70 treatment process options within six technology categories. It is important to note that while many of these technologies have been widely demonstrated in non-marine applications, only a few have been used for bench scale and pilot scale tests on marine dredged materials, and few are considered commercially demonstrated and available for this purpose. The total volume of material being handled on this project and its rate of production are also serious impediments to the use of these technologies.

3.5.2 Technology Screening Criteria

A wide range of treatment technologies from the above described processes have been assessed with respect to effectiveness in treating the specific parameters of interest in the BHNIP (PCBs, PAHs, metals) as well as the implementability of each process considering the volume and through-put expected from the project.

The critical characteristics of the Boston Harbor Dredging Project that impact the selection of the alternative technologies include the following:

- The types of contaminants that are of concern, based upon contaminant concentrations found during the sampling and testing program, are polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), petroleum hydrocarbons and trace metals. The ability of each technology to

treat these contaminants in the medium of dredged material is an important qualifier on effectiveness.

- Approximately 1.3 million cubic yards of dredged material may be unsuitable for unconfined ocean disposal and therefore could require treatment. Depending on the disposal option selected, production rates could range from 4,000 to 9,000 cy per day. This quantity and rate of dredged material would require a large scale facility for any of the applicable treatment technologies to be used. It is therefore, important to select demonstrated technologies that have operated on similar types of dredged materials at the scale required by the project schedule. This imposes a substantial constraint because there is very limited experience with operating treatment technologies at the scale of the proposed project for marine dredged materials.

- Implementation of any alternative treatment technology will result in residue streams to the environment. The ability of each technology to control these residue streams, and thus to mitigate environmental impacts, is another important consideration for effectiveness.

Appendix D in Volume 3 contains a copy of the technology questionnaire that was sent to the selected treatment providers. This questionnaire was reviewed and commented on by the DOWG and contains the technology screening criteria deemed important by the group. The results of the questionnaire are described in the next section.

3.5.3 Treatment Technology Rating

The treatment technology and disposal options were rated based upon their stated effectiveness, implementability and estimated cost (Table 3-24). For this study, effectiveness is defined as the ability of a process to meet the desired remediation goals while minimizing impacts to human health and the environment during the construction and implementation of the process and the overall reliability of the process. The relative rating criteria used a numerical scale of 1 to 4 with the following effectiveness ratings (Averett et al. 1990):

> Rating = 4. Process option can achieve the performance objective with greater than 99 percent efficiency. The process is highly reliable.

> Rating = 3. Process option can achieve the performance objective with 70 to 99 percent efficiency. This process is moderately reliable.

> Rating = 2. Process option can achieve the performance objective within 40 to 70 percent efficiency. This process is minimally reliable.

> Rating = 1. Process option is less than 40 percent efficient in achieving performance objectives. The process is not reliable.

Since both inorganic and organic contaminants have been detected in harbor sediments, the effectiveness of the process was rated for each contaminant group, for a maximum combined rating of eight.

The second factor evaluated was implementability, which is defined as the technical and administrative feasibility of using a treatment or disposal technology option. The implementability ratings are defined as follows (Averett et al 1990):

> Rating = 4. The process option is commercially available, has proven applicability to the contaminated sediments and has been field demonstrated at process rates similar to those proposed.
>
> Rating = 3. The process option is commercially available, has proven applicability to contaminated sediments and has been demonstrated on a pilot scale for sediments.
>
> Rating = 2. The process option has been demonstrated on a bench scale to be applicable to contaminated sediment and adequate information is available to proceed to a pilot-scale demonstration. Innovative technologies developed in laboratory studies may be assigned this rating.
>
> Rating = 1. The process option is conceptual or emerging and requires additional developmental work for application to contaminated sediment.

The last factor to be evaluated and rated was estimated cost. The ratings for estimated costs are as follows (Averett et al 1990):

> Rating = 4. Unit cost for the process option is less than $20 per cubic yard.
>
> Rating = 3. Unit cost for the process option is in the range of $20 to $100 per cubic yard.
>
> Rating = 2. Unit cost for the process is between $100 and $200 per cubic yard.
>
> Rating = 1. Unit cost for the process option is greater than $200 per cubic yard.

The individual rating scores for effectiveness, implementability and costs were added together to determine the composite score. Since the effectiveness of the processes on both inorganic and organic contaminants were rated separately, the maximum score for effectiveness is 8 and the maximum total score achievable is 16.

The composite scores ranged from 7 to 13 (Table 3-24). The lowest composite score was for the LADS System process. The LADS System combined thermal solidification/stabilization process had a low composite score because it is an emerging technology, has a high estimated unit cost (>$100/cy) and because no information was provided on this method's effectiveness on organic contaminants.

Commercial Recycling and Laidlaw Waste Systems received the highest ratings of the group. The Commercial Recycling solidification/stabilization process provides high effectiveness in treating both organic

and inorganic contaminants, relative ease of implementation and relatively low cost ($55 to $95/ton). Disposal of the dredged material in the Laidlaw landfill also received a high rating because of its effectiveness, relative ease of implementation and low cost ($50 to $65/ton). Although this option is highly rated, its implementation may be compromised by the volume of material that can be disposed of on a daily basis at the landfill, and the concentration at which some of the contaminants in the dredged sediments have been detected. The landfill would be able to accept up to 2,500 tons of material per day. The material would be accepted as long as the concentration of regulated contaminants (particularly PCBs and lead) did not exceed state standards.

These ratings of the different treatment and disposal options is based solely upon the information provided by the companies which completed and returned their survey questionnaires. Based on these responses, none of the technologies demonstrated experience in treating marine dredged sediments or any data which seems translatable to the BHNIP. If treatment of dredged materials is required as part of any future maintenance dredging, the development of a pilot test program for the highest rated technologies should be considered to collect additional information on the effectiveness, implementability and cost of using technology.

3.6 BENEFICIAL USES

There is a strong potential for a portion of the Boston Harbor dredged material to be used for one or more beneficial uses. The types and volumes of parent material may never be available again from Boston Harbor and therefore provide some unique mitigation opportunities for dealing with the silt. The parent material, specifically the rock and Boston Blue Clay could have a variety of beneficial uses.

It is also possible that the silt portion of the dredged material containing elevated levels of organics (PCBs, PAHs and petroleum hydrocarbons) and heavy metals could be utilized for daily cover at Massachusetts Category A lined landfills. However, the concentration of certain contaminants in the material must meet the DEP criteria for this type of use. One drawback to utilization of the dredged material for landfill cover is that each landfill is limited to receiving small quantities (50-250 cubic yards at the short-listed sites) of material for daily cover use. Stockpiling at landfills is limited due to the confined space available. Consequently, only a small portion of the Full Project quantity of dredged silt material (approximately 1.1 million cubic yards total) could be used in this manner.

Beneficial uses for rock and parent material are broader in scope and could include the uses described in the following paragraphs.

3.6.1 Use of Rock Material

A limiting factor to the beneficial use of any of the rock material is that some or all of the rock may be used to armor the in-channel disposal sites to prevent prop wash of deep draft vessels from affecting cap stability. The following are potential uses of rock remaining from the project after construction and project uses.

A. Fish Habitat Enhancement

There will be a large quantity (< 132,000 cubic yards) of rock removed from this project which could be utilized for constructing or improving a fishery habitat. For a perspective on the overall volume of material available, a containment structure with an approximate height of 15 feet and encompassing an area of over 5 acres could be constructed. A structure of this magnitude could be located in an in-harbor or offshore area considered to be in need of hard-substrate to enhance fisheries habitat but away from heavily utilized locations and high energy areas. A drawback to the rock to be removed for the BHNIP is that it will be mostly small in size (< 10") and mixed with some clay which would not provide large interstitial space for fisheries habitat. It would however, provide hard substrate for benthic organisms and some interstitial space which could increase the diversity and productivity of habitat niches.

B. Shoreline Protection

Some of the rock material could be utilized for shoreline protection along certain areas in and around Boston Harbor. Specifically, there are waterfront areas in Chelsea and Mystic Rivers and along the Main Ship Channel that may be structurally unstable due to erosion from inadequate protection. As an example, an area that may benefit from increased shoreline protection is a city property located along the south shore of the Chelsea Creek near Condor Street. Additionally, there may be shoreline areas outside of Boston Harbor proper that could benefit from increased protection. Massport does not have any waterfront areas that could readily use the rock material for protection. However, due to the size of the rock material after blasting (10" diameter) its use as shoreline protection will be limited.

C. Containment Site Development/Armoring

The rock removed from dredging could be useful for developing a containment site for the unconsolidated (silty) dredged material. One such use could be for the construction of subaqueous berms that could assist in retaining the finer material during disposal operations at some types of sites. Likely sites for this use would include the subaqueous sites in the outer harbor and Spectacle Island CAD. The rock could particularly be useful in providing armor aggregate for a portion of the containment berms. However, it is expected that a substantial quantity of other larger size rock may be needed to completely protect the exposed faces of the containment berms.

As stated earlier, some quantity of the rock may be used to armor the in-channel disposal areas in the areas that may subject to the highest prop wash effects (Inner Confluence). The final quantity expected to be used for armoring will be determined during the final design of this disposal option.

D. Upland Fill/Commercial Reuse

The dredged rock mixed with clay could be useful for various upland filling applications where clean fill is needed (highway construction, etc.). It would be relatively easy to handle and transport, and could provide a suitable foundation for

certain light commercial or industrial uses. Additionally, the rock could have some commercial reuse potential as construction aggregate. Its clay content may decrease its utility.

3.6.2 Use of Parent Material

A. Open Water Disposal Cap

There will be approximately 2 million cubic yards of parent material (primarily clay and sand/gravel) available from the Boston Harbor Dredging Project. The clay fraction is highly cohesive and could be useful as capping material at an open water disposal site. Capping would be initiated soon after the disposal of silt material was completed. The operation would be conducted using traditional barge scows with bottom operating doors. The material would be point dumped within specific radii from the center of the silt material to form a continuous mound deposit of approximately I meter thick on top of the silt. This would effectively provide a clay cap which would seal off the silt from the environment.

However, since the open water options have been dropped from further consideration as disposal sites for this phase of the project, based on DEIR/S comments, there will be no opportunity to demonstrate capping with the parent material.

B. Nearshore Containment Cap

The parent material could also be used in a similar fashion for capping any of the nearshore containment. However, because of limited barge access to some of these sites, it may be necessary to utilize land-based equipment or a barge mounted crane for offloading the sediments from barges for cap placement.

C. Subtidal/Intertidal Habitat Creation

The Reserved Channel and Little Mystic Channel containment options will require surface material that would be suitable for establishment of subtidal and intertidal habitat. The parent material to be dredged would be suitable as base material that could be placed directly onto the silty dredged material in the containment site. A surface layer of clean sand/silt mixture placed over the clay would provide substrate favorable for benthic recruitment and establishment of vegetation.

D. Landfill Liner/Cap/Closure Material

The parent material could also be useful for lining landfills or other upland sites that may require liner material. Since the parent material is primarily clay, it is highly impermeable and could be suitable for this purpose. This material could also be useful for capping or covering some of the silt to be dredged from this project that may require burial. The predominately clay parent material may also be useful as final closure material at certain landfills. Massachusetts DEP, Division of Solid Waste Management has identified a state-wide need of 7 million cubic yards of clay for municipal landfill capping and a need for at least an equal amount of fill for landfill grading prior to capping.

The Central Artery/ Third Harbor Tunnel project has been working with the DEP in developing a clay distribution program to

meet part of this need. The CA/T has identified some 82 communities in Massachusetts that could use a portion of the clay coming from the CA/T project. Appendix H in Volume 3 of this FEIR/S contains the application form and requirements for communities to receive clay from the CA/T project.

The Corps is willing to investigate ways of working with the DEP to further this program. However, a limiting factor on the Corps is that the project's parent material is considered improvement material and therefore, its dredging and disposal must consider the least costly option to meet the 1988 Feasibility Study cost-effectiveness evaluation. The parent material is suitable for unconfined ocean disposal at the MBDS, which is also the least costly option. Beneficial use of the parent material cannot increase the cost of its disposal above that of using the MBDS. However, to advance the interests of the DEP, the project team evaluated means of making the parent material available for use at municipal landfills if there is still a need and interest after CA/T project benefits are realized.

Trucking and transporting project clay would be cost prohibitive. However, the project team investigated barge access facilities within the Commonwealth that could serve as distribution points for project parent material. Assuming that a 15-foot minimum depth would be required for a barge, the project team identified several ports and the unlined municipal landfills that could be served from them (see Table 3-25). Should these communities express an interest in receiving project clay, individual arrangements may be made with the Corps to barge a specific quantity of clay to a designated site for off-loading, handling, transporting and stockpiling at the municipalities expense.

Based on the contaminant profile and physical characteristics of the parent material, the material would be suitable for liner material, intermediate cover, a subgrade layer, or a final cap. Should a municipality demonstrate an interest in this material, further testing will be required to ascertain the suitability of the material under DEP Policy #BWP-94-037 and Solid Waste Management regulations. The project team will continue to coordinate interests in the beneficial re-use of the clay with the DEP.

3.6.3 Summary of Beneficial Uses

In summary, beneficial uses of rock and parent material may include a variety of enhancement and containment purposes as follows:

ROCK (Amount available: approximately 132,000 cubic yards)

- Fish habitat enhancement
- Shoreline protection
- Containment site development/armoring
- Upland fill
- Commercial reuse (construction aggregate)

PARENT MATERIAL (Amount available: approximately 3.3 million cubic yards)

- Open water disposal cap
- Nearshore containment site cap
- Landfill liner/cap
- Landfill final closure material
- Other upland site liner/cap

3.7 PREFERRED DISPOSAL OPTION

The preceding discussions have demonstrated the complexity of identifying and combining sites to form disposal options. This section will assess the issues involved in critically evaluating the merits of the disposal options to select the preferred option.

Selection of the Preferred Disposal Alternative will be based on screening the options through a series of key criteria which include:

- ability of disposal sites/methods to meet regulatory criteria for receiving material
- minimization of negative environmental impacts
- maximization of environmental benefits
- reasonable capacity for this project
- reasonable in light of logistics, technology and cost.

Environmental impact is the most important criterion. Land-based (landfill and development of new inland or coastal sites) and aquatic (nearshore and various open water alternatives) disposal sites would inherently involve different types of impacts (Table 3-7) since different resource types would be involved in each case. Thus, while comparisons among land-based alternatives and among aquatic alternatives are fairly straight forward, comparisons between upland and aquatic alternatives are more complex. The types of environmental impacts that would weigh most heavily against a site being included in the preferred alternative (based on sensitive resources identified in this study) would include unmitigatable risks to:

- marine and/or upland habitat
- wetlands
- anadromous fish passage
- important resident fish and shellfish
- water quality
- threatened and endangered species
- traffic (marine and/or roadway)
- neighborhood impacts

Distinctions can be made among disposal alternatives based on their ability to provide environmental benefits (Table 3-9), although, again, it is difficult to weigh benefits against each other, particularly on the generic level. However, benefits that would weigh most heavily toward including a particular alternative would include:

- maximizing use of parent material
- use of any available sand or gravel
- providing capacity for future dredging needs
- providing clean bottom habitat within Boston Harbor
- providing alternatives which are practicable and achievable

Identifiable future disposal estimates (i.e., 50-year maintenance for Boston Harbor) point out the necessity to evaluate disposal options on both the generic and specific levels. As indicated in Section 3.4, identifying capacity for the BHNIP is the

first challenge. Adding future dredging projections to the equation makes the evaluation more complex but is critical to the process and was identified as such in the MEPA scope. The preferred disposal option should include a site or sites and methods to accommodate future dredging as well as the current need.

Cost, in addition to logistics and technology, is a factor in determining practicability of the disposal options. Final cost comparisons among disposal options cannot be made without considering specific sites. An acceptable benefit/cost ratio must be reached in order to qualify for Federal participation in a navigation improvement project. The three major costs used to compute the benefit/cost ratio include: design, dredging and disposal costs incurred to deepen the Federal Channels (parent material); design, dredging and disposal costs incurred to deepen those berths that receive direct project benefits (silt and parent material); and costs associated with maintenance of the improvement project for its economic life (50 years). Costs to dredge and dispose of silt (maintenance material) from the Federal channel during initial construction of the improvement project is not included as part of the improvement project cost as this is considered maintenance of the existing channels. The total improvement cost must be compared to the benefits that the deeper project will provide. Therefore, the benefit-to-cost ratio for the project or each separable increment of the project must be at least 1:1 for the project to qualify for Federal funding.

While a particular disposal option may pass the Federal participation criteria, the sponsor may find its cost contribution unacceptably high. There is no cost criterion that applies to the project related berths, however, affordability relative to the perceived benefits in site management would likely be used by individual owners in their decision to participate.

Identification of suitable disposal options for BHNIP has been an open process involving valuable collaboration with the project's working groups. The DEIR/S was another step in that process.

Table 3-26 provides a summary of the principal impacts associated with the twenty-four disposal sites and one treatment technology that remained potentially suitable for BHNIP material disposal after site screening. The existing conditions at each site and principal environmental impacts associated with its use are provided in Attachment 1 in Volume 1 of this FEIR/S.

The next chapter provides a detailed environmental analysis of the sites described in Attachment 1 and listed on Table 3-1 as having survived the site screening process. The Chapter also includes a practicability screening applying cost, technology and logistics, culminating in a selection and description of the preferred alternative. That alternative is in-channel disposal with sand capping.

The In-Channel disposal scenario assumes that the silt material will be dredged from each channel and placed on a barge, while deeper cells will then be dug in the Mystic River, Chelsea Creek and Inner Confluence channels (parent material); the silt would then be placed within the cells and capped with sand. Parent material removed from the trench would be disposed at MBDS. Each

channel/tributary would then contain its own capped silt material. The environmental resources impacted for this disposal alternative are the same as for the dredging site.

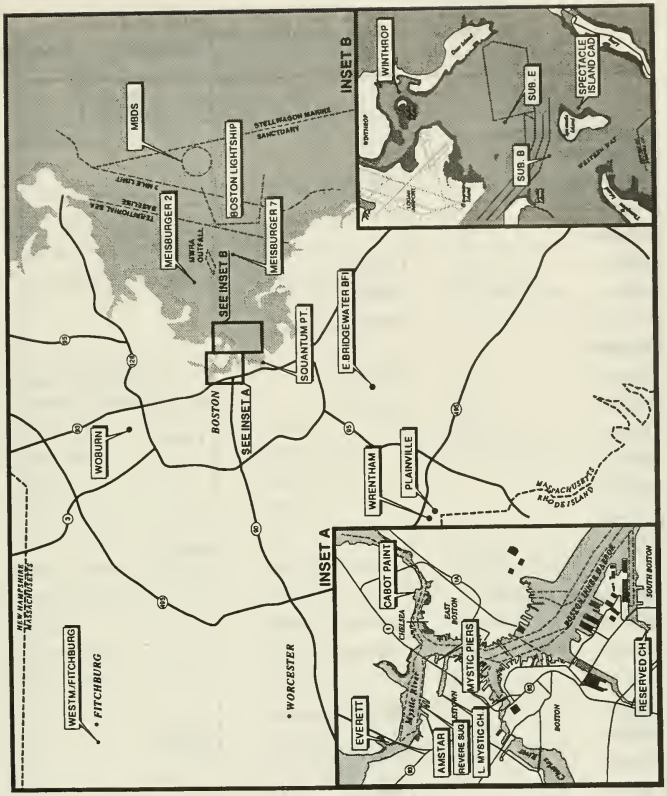
Benefits from this alternative include keeping the silt material within the channel to be dredged, thus reducing the amount of silt exposed to biological resources elsewhere and keeping transportation costs, vessel traffic disturbances and socio-economic impact to a minimum.

The proposed disposal sites occur in tributaries currently used by ship traffic. The U.S. Coast Guard would need to coordinate between ships needing to use the tributary and disposal activities. However, since material would essentially be disposed at or near the same place it is dredged, only barges for temporary storage and those required to dispose of excess parent material would have to be dealt with; major barge movement within the Harbor should not be necessary.

The characteristics of the underlying sediments in the channels have been described in Section 2.2 of the DEIR/S as clean parent material. Bulk sediment analysis indicated that no parameter exceeded Category I limits. The channel would be filled with silt and capped with sand. The remaining parent material would be disposed at the MBDS or other suitable site. Since the channels are currently covered with silt material, returning the silt to its place of origin and capping it with sand would provide an environmental benefit.

The disposal site would end up, as proposed, 3.0 to 5.0 feet deeper than the channel's current authorized depth. The area would of course remain subtidal; the substrate would change from a silt material to sand with gravel or rock armoring in areas affected by prop wash. The benthic community may change as a result of this sediment change but should be "healthier" because the availability of contaminants for bioaccumulation will be reduced, at least until future siltation occurs. No federally or state-listed threatened or endangered species are expected to be at risk from this activity in the channel and tributaries.

Each of the channels falls within the Designated Port Areas of Boston Harbor (e.g., Mystic River, Chelsea Creek, East Boston and South Boston designations) under State jurisdiction (310 CMR 10.00) and within Tidal Water jurisdiction under Section 404 of the Federal Clean Water Act. Since these proposed disposal sites are part of the overall maintenance dredging operation, their construction will not impact these regulated resources beyond the impacts of the dredging itself, other than from increased silt plumes during disposal. ADDAM's model results indicate that these plumes should not directly impact economically important fish and shellfish resources. Any impacts would be temporary and, upon capping and project completion, the resources should restore themselves to natural conditions. Newly-exposed substrate and clean capping materials will provide better substrate conditions for benthic community development in the near-term.



Boston Harbor Dredging Project EIR/S	*Figure 3-1* Locations of potential disposal sites extensively evaluated.
N *Scale:* 0 10 *Approx. Scale in Miles*	*Source:* USGS Quadrangles Revised by NAI to reflect pertinent site conditions.

TABLE 3-1. POTENTIAL DISPOSAL SITE LISTS BY CATEGORY PRODUCED AT THE END OF EACH SCREENING PHASE.

PHASE 1	PHASE 2	PHASE 3 (DEIR/S)
LAND-BASED OPTIONS:		
Land-based Inland		
BRN-06	BRN-06	
CAN-17		
EBROOK		
HLB-13	HLB-13	
NAT-02	NAT-02	
NOR-02	NOR-02	
RAYNHAM		
RED-03	RED-03	
SAG-02	SAG-02	
W-495		W-495
WEY-13		
WIL-06		
WIL-07		
WOB-11		WOB-11
Land-based Coastal		
BOS-13	BOS-13	
BOS-23	BOS-23	
BOS-25		
BOS-31	BOS-31	
EVR-04		EVR-04
LOGAN		
LYN-02	LYN-02	
MAL-01		
CHAR-01	CHAR-01	
PROV		
QUI-03		QUI-03
QUI-09	QUI-09	

TABLE 3-1. (CONTINUED)

PHASE 1	PHASE 2	PHASE 3 (DEIR/S)
Landfills		
Agawam		
E. Bridgewater	E. Bridgewater	E. Bridgewater
Fall River	Fall River	
Plainville	Plainville	Plainville
Fitchburg/Westminister	Fitchburg/-Westminister	Fitchburg/-Westminister
	GCR Peabody*	
AQUATIC OPTIONS: Aquatic Shoreline Sites		
Amstar	Amstar	Amstar
Cabot Paint	Cabot Paint	Cabot Paint
CHEL-01	CHEL-01	
FPC	FPC	
LMC	LMC	LMC
Mystic Piers	Mystic Piers	Mystic Piers
Northend Park	Northend Park	
ResChn	ResChn	ResChn
Revere Sugar	Revere Sugar	Revere Sugar
Spec CDF	Spec CDF	
	Hangman's Island*	
	Island End River*	
Subaqueous Depressions		
Subaq B	Subaq B	Sub B
Subaq D		
Subaq E	Subaq E	Subaq E
Subaq F		
CHEL-02	CHEL-02	
Winthrop		Winthrop

TABLE 3-1. (CONTINUED)

PHASE 1	PHASE 2	PHASE 3 (DEIR/S)
Borrow Pits		
Willet I	Willet I	
Willet III	Willet III	
Meis 2		Meis 2
Meis 7		Meis 7
	Spec Is CAD	Spec Is CAD
In-Channel Sites		
		Chelsea Creek**
		Mystic River**
		Inner Confluence**
Existing Disposal Sites		
MBDS	MBDS	MBDS
Boston Lightship	Boston Lightship	Boston Lightship

*Added after DOWG meeting, 1/25/93
**Added after DOWG meeting, 4/15/93

TABLE 3-2. ADDITIONAL INFORMATION COLLECTED FOR NEARSHORE AQUATIC, IN-CHANNEL, BORROW PITS, SUBAQUEOUS AREAS AND EXISTING DISPOSAL SITES (OCTOBER 1994)

SITE	BENTHOS SPI[1]	BENTHOS	FISHERIES: PELAGIC[2]	FISHERIES: DEMERSAL[3]	LOBSTER TRAPS
Nearshore Aquatic					
Mystic Piers	X	X			
Revere Sugar	X	X	X		X
Amstar	X	X			
Cabot Paint	X	X			
Little Mystic Channel	X	X	X		X
Reserved Channel		X	X		X
In-Channel/Borrow Pits					
In-Channel Mystic River	X	X		X	X
In-Channel Chelsea Creek	X	X		X	X
In-Channel Inner Confluence	X	X		X	X
Spectacle Island	X	X	X		X
Meisburger 2 & 7	X	X	X		X
Subaqueous					
Subaqueous B	X	X			
Subaqueous E	X	X		X	X
Winthrop Harbor					
Disposal Sites					
Boston Light Ship	X	X		X	X

[1] Sediment Profile Camera

[2] Gillnets

[3] Otter Trawl

TABLE 3-3. CHARACTERISTICS OF GENERIC DISPOSAL ALTERNATIVES.

CHARACTERISTIC	LINED LANDFILL (CATEGORY A)	UNLINED LANDFILL (CATEGORY B)	LAND-BASED (NON-LANDFILL)	AQUATIC SHORELINE CONTAINMENT	OPEN WATER	OPEN-WATER WITH CONTAINMENT
Potential Environmental Problems	• Leachate impacts • (Minimal since lined)	• Leachate impacts	• Groundwater contamination • Wetland impacts	• Contaminant migration • Burial impacts	• Water column impacts • Benthic impacts • Bioaccumulation	• Contaminant migration • Burial impacts
Major Testing Requirements	• Bulk analysis • TCLP[a] • Elutriate	• Bulk analysis • TCLP • Elutriate	• Bulk analysis • TCLP • Elutriate	• Bulk analysis • TCLP • Elutriate	• Bulk analysis • Benthic toxicity • Bioaccumulation	• Bulk analysis • Elutriate or water quality modelling • Benthic impacts • Bioaccumulation
Available Options	• Daily cover • Disposal with burial	• Unconfined disposal • Contouring/grading material • Daily cover	• Unconfined disposal • Confined disposal • Reuse	• Habitat creation • Upland use	• Unconfined disposal • Capping	• Habitat enhancement • Burial
Design Considerations	• Existing site design • Transportation	• Existing site design • Transportation	• Capacity • Containment • Monitoring • Transportation	• Capacity • Containment • Monitoring • Transportation	• Capacity • Containment • Monitoring • Transportation	• Capacity • Containment • Monitoring • Transportation
Available Control Measures	• Mix with cleaner materials • Dewatering	• Diking • Runoff control • Dewatering	• Diking • Runoff control • Leachate control • Dewatering	• Bulkheading • Diking • Subaqueous berm • Capping	• Point dumping • Capping	• Subaqueous berm • Borrow pit • Capping • Point dumping

[a]TCLP = toxic concentrations leaching potential

TABLE 3-4. MASSACHUSETTS REGULATORY GUIDELINE LEVELS OF DREDGED MATERIALS FOR VARIOUS DISPOSAL ALTERNATIVES.

		OPEN WATER DISPOSAL						UPLAND DISPOSAL			
		MASSACHUSETTS SEDIMENT CLASSIFICATION						LANDFILL CATEGORY			
		I[a]	II[b]	III[c]	A	B	C	(LINED) A[d]	(UNLINED) B	MIN. BULK SOIL CONC.[e] FOR TCLP ANALYSIS (ppm)	TCLP REGULATORY LEVELS[f] (mg/l)
BULK ANALYSIS	(ppm)										
Mercury		<0.5	0.5-1.5	>1.5				10	2		
Lead		<100	100-200	>200				500	500		
Zinc		<200	200-400	>400				40	40		
Arsenic		<10	10-20	>20				25	14		
Cadmium		<5	5-10	>10				500	100		
Chromium		<100	100-300	>300							
Copper		<200	200-400	>400							
Nickel		<50	50-100	>100				2	2		
Total PCBs		<0.5	0.5-1.0	>1.0				100	100		
Total PAHs								10	4		
Total VOCs								1000	500		
Total PHC											
Volatile Solids Water	(%)				<5	5-10	>10				
Content	(%)				<40	40-60	>60				
Silt/Clay	(%)				<60	60-90	>90				
Oil & Grease	(%)				<0.5	0.5-1.0	>1.0				
TCLP										100	5
Arsenic										20	1
Cadmium										100	5
Chromium										100	5
Lead										4	0.2
Mercury										20	1
Selenium										100	5
Silver											

[a] = normally approved for unconfined open water disposal
[b] = the presence of several parameters in this category may require bioassay and bioaccumulation testing for evaluating open water disposal
[c] = the presence of one or more parameters in this category will most likely require bioassay and bioaccumulation testing for evaluating open water disposal
[d] = dredged material which exceeds any of the limits may be mixed with cleaner material to bring the material into compliance with this classification
[e] = TCLP analysis would be needed for those parameters that exceed any listed threshold
[f] = material has non-hazardous characteristics if listed regulatory levels are not exceeded using the TCLP test methods

TABLE 3-5. EVALUATION OF SUITABILITY OF BOSTON HARBOR NAVIGATION IMPROVEMENT PROJECT SEDIMENTS FOR VARIOUS DISPOSAL ALTERNATIVES.

DREDGE SITE		MAAS Bar DISPOSAL SITE (UNCONFINED)			OPEN WATER AQUATIC						MARSHORE AQUATIC W/ CONFINEMENT			UPLAND COASTAL			UPLAND INLAND			LINED LANDFILL		
					UNRESTRICTED			(CAPPING)														
		SILT	SAMENT	ROCK	SILT	SAMENT	ROCK	SILT	SAMENT	ROCK	SILT	SAMENT	ROCK	SILT	SAMENT	ROCK	SILT	SAMENT	ROCK	SILT	SAMENT	ROCK
Reserved Channel	FP	U	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	A,S	S	U	A,B,C,S	S
Conley	P	U	S	NA	U	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	D,E	A,B,C,S	NA
Army Base	P	U	S	NA	U	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	D,E	A,B,C,S	NA
Boston Edison (Barge Berth)	P	U	S	NA	U	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	D,E	A,B,C,S	NA
Boston Edison (Intake)	P	N	NA	NA	N	NA	NA	S	NA	NA	S	NA	NA	S	NA	NA	S	NA	NA	D,E	NA	NA
Main Ship Channel	FP	N	S	S	N	S	S	S	S	S	S	S	S	S	S	S	S	S	S	D,E	A,B,C,S	S
North Jetty	P	N	S	NA	N	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	D,E	A,B,C,S	NA
Mystic Piers	P	N	S	NA	N	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	D,E	A,B,C,S	NA
Chelsea River	FP	N	S	NA	N	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	U	A,B,C,S	NA
Eastern Minerals	S	N	S	NA	N	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	D,E	A,B,C,S	NA
Gulf Oil	P	U	S	NA	U	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	D,E	A,B,C,S	NA
Mystic River	FP	N	S	S	N	S	S	S	S	S	S	S	S	S	S	S	S	A,S	S	U	A,B,C,S	S
Moran	P	N	NA	NA	N	NA	NA	S	NA	NA	S	NA	NA	S	NA	NA	S	NA	NA	D,E	NA	NA
Revere Sugar	P	N	S	NA	N	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	D,E	A,B,C,S	NA
Distrigas	P	N	S	NA	N	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	D,E	A,B,C,S	NA
Proleriza	P	N	S	NA	N	S	NA	S	S	NA	S	S	NA	S	S	NA	S	A,S	NA	D,E	A,B,C,S	NA

Keys: FP = Federal project; P = Non-Federal project

A = suitable as liner
B = suitable as closure material
C = suitable as daily cover without mixing
D = suitable as solid waste for disposal in a lined landfill
E = suitable as daily cover with mixing
N = unsuitable
NA = not applicable
S = suitable
U = unresolved; treated as unsuitable for disposal option alternatives analysis

TABLE 3-6. SUMMARY OF POTENTIAL SITE PREPARATION, MANAGEMENT REQUIREMENTS FOR USE OF GENERIC DISPOSAL ALTERNATIVES.

	UPLAND			AQUATIC			
	LANDFILL	UPLAND INLAND	UPLAND COASTAL	NEARSHORE	BORROW PITS	OPEN WATER	EXISTING DISPOSAL SITES
SITE PREPARATION							
•Baseline investigations		X	X	X	X	X	
•Permitting	X	X	X	X	X	X	X
•Acquisition		X	X	X			
•Dredging			X		X		
•Containment structure-dike		X	X			X	
-berm				X			
-bulkhead				X			
•Access road/rail		X					
•Alteration of navigational channel						X	
•Liner		X	X				
MATERIAL PREPARATION							
•Dewatering	X	X	X				
•Mixing	X						
TRANSPORTATION							
•Barge	X	X	X	X	X	X	X
•Truck	X	X	X	X			
•Rail	X	X					
SITE MANAGEMENT							
•Runoff control	X	X	X				
•Closure							
-landscaping		X	X				
-dredged clay	X	X	X	X		X	X
-soil		X	X				
-structure				X			
-marine organic				X			
-marine mineral					X		
-prior demonstration of success							X
-marine habitat				X	X		
•Burial		X	X		X	X	X
•Daily Cover	X	X	X				

TABLE 3-7. POTENTIAL IMPACTS FROM SILT DISPOSAL AT GENERIC ALTERNATIVE DISPOSAL SITES.

IMPACT	LAND-BASED			AQUATIC		SUBAQUEOUS		BORROW PITS	EXISTING SITES		SOLIDIFICATION
	LANDFILL	INLAND	COASTAL	TOTAL	PARTIAL	OUTER HARBOR	CHANNEL	W/ CAP	W/ CAP	W/O CAP	
Exceeds Sediment Criteria										X	
Loss of Habitat											
Terrestrial		X	X								
Wetland (F.W.)			P								
Marine subtidal				X	T	T	T	T	T	T	
Marine intertidal			T	X							
Alteration of Habitat											
Terrestrial		X	X								
Wetland (F.W.)		P	P								
Marine subtidal			T	X	X	X	X	T	T	T	T
Marine intertidal			X	X	P						
Water Quality											
Freshwater		P									
Marine			T	T	T	T	T	T	T	T	
Current Use (Displacement)	X	X	X	X	X						
Socioeconomic											
Traffic											
Truck	X	X	X								
Barge	X	X	X	X	X	X	X	P	P	P	P
Historic/ Archeological		P	P	P	P	P	P	P			
Emigration Potential for Contaminants											
During disposal						P	P	P	P	P	
Prior to containment						P	P	P	P		
Volatization		P	P								
Long-term	P	P	P		P	P	P	P	P	X	
Bioaccum. potential						T	T	T	T	X	

Key: X = Impact; P = Possible impact; T = Temporary impact.

TABLE 3-8. IMPACTS CAUSED BY USING SPECIFIC UPLAND SITES FOR BOSTON HARBOR DREDGED MATERIAL DISPOSAL.

RESOURCE	PLAINVIEW/ LAIDLAW LANDFILL	WESTMINSTER LANDFILL	EAST BRIDGEWATER LANDFILL	WRENTHAM
SITE DESIGN	•Dewatering facility at Mystic Pier or North Jetty •No special site modifications required •Available capacity: daily cover < 500 cy/day •Waste < 150-200 cy/day	•Dewatering facility at Mystic Pier or North Jetty •No special site modifications required •Available capacity: daily cover < 250 cy/day •Waste < 200 cy/day	•Dewatering facility at Mystic Pier or North Jetty •No special site modifications required •Available capacity: daily cover < 400 cy/day •Waste < 75 cy/day	•Dewatering facility at Mystic Pier or North Jetty •Site modification from undeveloped forest/shrub to lined landfill •Footprint approx. 60 acres •Capacity approx. 785,500 cy
WATER QUALITY	None			•No groundwater impacts •Possible temporary surface water impacts from sedimentation and contaminants
MARINE INTERTIDAL	None			
MARINE SUBTIDAL	None			
SHELLFISH	None			
FINFISH	None			
FRESHWATER AQUATIC RESOURCES	None			
WETLAND VEGETATION, WILDLIFE	None			•Permanent loss of 9 ac. wetland •Permanent loss of habitat to resident species and fragmentation of wooded land
THREATENED & ENDANGERED SPECIES	None			Possible habitat for northern hairstreak and Philadelphia panic grass
HISTORIC & ARCHEOLOGICAL	None			
SOCIOECONOMIC & LANDUSE	No change in land use, but use for dredge material disposal would preempt other uses			Possible change from undeveloped forest and shrubland to lined containment facility
TRAFFIC	Increase in truck traffic for transporting dredged material to landfill			•Increase in truck traffic during construction and dredge disposal phase •Heavy truck use already occurs from adjacent gravel operation

TABLE 3-8(CONTINUED). IMPACTS CAUSED BY USING SPECIFIC UPLAND SITES FOR BOSTON HARBOR DREDGED MATERIAL DISPOSAL.

RESOURCE	WOBURN	EVERETT	SQUANTUM POINT
SITE DESIGN	•Dewatering facility at Mystic Pier or North Jetty •Capping closed municipal landfill with lined facility • Footprint=25 acres • Capacity=158,600 cy	•Dredge barge lane •Site modified from abandoned urban land to landfill • Footprint=6 acres • Capacity=70,000 cy	•Dredge barge lane •Construct lined containment berm and fill with dredged materials up to 10 feet deep •Dewater through detention basin, cap when dry • Footprint=18 acres • Capacity=210,000 cy
WATER QUALITY	•May improve groundwater quality by capping landfill •Possible temporary surface water impacts from sedimentation and contaminants	•Temporary local increase in suspended solids during dredging •Temporary release of contaminants during dredging	
MARINE INTERTIDAL	None	•Dredging of 2 acres of intertidal habitat •Potential siltation during dredging and barge manuevering	Permanent loss of approximately 0.3 ac. of fine-grained tidal flat and 0.03 ac. of salt marsh
MARINE SUBTIDAL	None	Dredging of approximately 0.03 ac. of fine-grained sediment and disturbance during barge manuevering will result in temporary loss of benthic production	Alteration of approximately 1.4 ac. of fine-grained habitat
SHELLFISH	None	No harvestable shellfish beds in area	Temporary impact to mussel and softshell clam habitat
FINFISH	None	Temporary disturbance to finfish habitat.	Temporary disturbance to finfish habitat.
FRESHWATER AQUATIC RESOURCES	Possible temporary impacts to tributary to Hall's Brook	None	
WETLAND VEGETATION, WILDLIFE	•Permanent loss of portion of 1 ac. wetland •Permanent loss of early successional field and wooded habitat	•No freshwater wetland impacts •Loss of open land in an urban setting	•Permanent loss of approximately 0.33 ac. of wetland •Permanent loss of shrubland bird habitat and disturbance of salt marsh tidal flat habitat
THREATENED & ENDANGERED SPECIES	None	None	Loss of short-eared owl migratory/wintering habitat
HISTORIC & ARCHEOLOGICAL	None	Jacknife drawbridge within 1000 ft of site	None
SOCIOECONOMIC & LANDUSE	Permanent capping of closed municipal landfill	Permanent change from abandoned urban land to landfill	None
TRAFFIC	•Construction traffic •Increase in truck and rail traffic due to transport of dredged material to landfill	•Construction traffic •Dredged material transported by barge	•Construction traffic •Dredged material transported by barge

TABLE 3-9. POTENTIAL BENEFITS OF DREDGED MATERIAL DISPOSAL ALTERNATIVES.

BENEFIT	UPLAND			AQUATIC SHORELINE		SUBAQUEOUS		BORROW PITS	EXISTING DISPOSAL SITES		SOLIDIFICATION
	LANDFILL	INLAND	COASTAL	TOTAL	PARTIAL	OUTER HARBOR	CHANNEL	W/ CAP	W/ CAP	W/O CAP	
Remove/Isolate Contaminated Sediment from Environment	X	X	X	X	X	X	X	X	X		X
Cover Existing Contaminated Sediments	P			X	X				P		
Enhance Resource/Habitat		P	P		X				P		X
Economic Benefits				P				P			
Cap Existing Disposal Site	X								X	X	
Beneficial Use of Parent Material	X	X	X	X	X	X	X	X	X		
Use of Existing On-site Materials								X			
Future Use of Impacted Area	X	P	P	X	X	X			X	X	P

Key: X = Benefit; P = Possible benefit

TABLE 3-10. IMPACTS CAUSED BY USING SPECIFIC AQUATIC SHORELINE SITES FOR BOSTON HARBOR DREDGED MATERIAL DISPOSAL.

RESOURCE	MYSTIC PIERS		REVERE SUGAR		AMSTAR	
	TOTAL FILL	PARTIAL FILL	TOTAL FILL	PARTIAL FILL	TOTAL FILL	PARTIAL FILL
SITE DESIGN	Bulkhead harbor face; fill behind silt curtain/weir to MHW or higher. Dregline to position sediments. Footprint=2.7 ac.; capacity=197,000 cu. yds.	Bulkhead harbor face; fill behind silt curtain/weir to 0 ft MLW, cap with sand to MLW. Dregline to position sediments. Footprint= 2.7 ac.; capacity=68,000 cu. yds.	Bulkhead harbor face; fill behind silt curtain/weir to MHW or higher. Dregline to position sediments. Footprint=3.7 ac.; capacity=204,000 cu yds.	Bulkhead harbor face; fill behind silt curtain/weir to 0 ft MLW, cap with sand to MLW. Dregline to position sediments. Footprint= 3.7 ac.; capacity=85,000 cu yds.	Bulkhead harbor face; fill behind silt curtain/weir to MHW or higher. Dregline to position sediments. Footprint=3.5 ac.; capacity=241,000 cu yds.	Bulkhead harbor face fill behind silt curtain/weir to 0 ft MLW, cap with clay to MLW. Dregline to position sediments. Footprint= 3.5 ac.; capacity=129,000 cu yds.
WATER QUALITY	•Permanent loss of 36 million gal. of Boston Harbor capacity, no impact on current velocity •Dewatering controls needed.	•Permanent loss of 29 million gal. of Boston Harbor capacity, no impact on current velocity •Dewatering controls needed	•Permanent loss of 21 million gal. of Boston Harbor capacity, no impact on current velocity •Dewatering controls needed.	•Permanent loss of 27 million gal. of Boston Harbor capacity, no impact on current velocity •Dewatering controls needed.	•Permanent loss of 53 million gal. of Boston Harbor capacity, no impact on current velocity •Dewatering controls needed.	•Permanent loss of 39 million gal. of Boston Harbor capacity, no impact on current velocity •Dewatering controls needed.
MARINE INTERTIDAL	Permanent loss of macroalgae, barnacle, and blue mussel production on hard substrate	No loss of hard substrate	Permanent loss of macroalgae, barnacle, and littorina snail production on hard substrate	No loss of hard substrate	•Permanent loss of barnacle, mussel and green algae production on hard substrate •Permanent loss of gravel beach	No loss of hard substrate
MARINE SUBTIDAL	Loss of 2.7 acres fine-grained soft habitat	•Alteration of 2.7 ac. fine-grained soft substrate. •Capping of existing contaminants •Loss of piling and bulkhead (hard substrate)	Loss of 3.7 acres fine-grained soft habitat	•Alteration of 3.7 ac. fine-grained soft substrate. •Capping of existing contaminants •Loss of piling and bulkhead (hard substrate)	Loss of 3.5 acres fine-grained soft habitat	•Alteration of 3.5 ac. fine-grained soft substrate. •Capping of existing contaminants •Loss of piling and bulkhead (hard substrate)
SHELLFISH	Loss of intertidal mussels on pilings		None			
FINFISH	•Mortality of demersal fish eggs; larvae and adults trapped behind bulkhead. •Permanent loss of finfish refuge and foraging habitat	•Mortality of demersal fish eggs; larvae and adults trapped behind bulkhead. •Temporary loss of finfish refuge and foraging habitat	•Mortality of demersal fish eggs; larvae and adults trapped behind bulkhead. •Permanent loss of finfish refuge and foraging habitat	•Mortality of demersal fish eggs; larvae and adults trapped behind bulkhead. •Temporary loss of finfish refuge and foraging habitat	•Mortality of demersal fish eggs; larvae and adults trapped behind bulkhead. •Permanent loss of finfish refuge and foraging habitat	•Mortality of demersal fish eggs; larvae and adults trapped behind bulkhead. •Temporary loss of finfish refuge and foraging habitat
FRESHWATER AQUATIC RESOURCES	None					
WETLAND VEGETATION, WILDLIFE	Permanent loss of 2.7 acres subtidal wetlands Possible bird forage habitat	Alteration of substrate of 2.7 acres subtidal wetlands. Possible bird forage habitat	Permanent loss of 3.7 acres subtidal wetlands Possible bird forage habitat	Alteration of substrate of 3.7 acres subtidal wetlands. Possible bird forage habitat	Permanent loss of 3.5 acres subtidal wetlands Possible bird forage habitat	Alteration of substrate of 3.5 acres subtidal wetlands. Possible bird forage habitat
THREATENED & ENDANGERED SPECIES	None					
HISTORIC & ARCHEOLOGICAL	None					
SOCIOECONOMIC & LANDUSE	•Conversion of aquatic habitat to fastland. •Proposed future use compatible with neighborhood.	Eliminate future potential use in commercial port activity	•Conversion of aquatic habitat to fastland. •Proposed future use compatible with neighborhood.	Eliminate future potential use in commercial port activity	•Elimination of MWRA floating dock on eastern edge of site. •Conv. of aquatic hab. to fastland •Prop. future use of compatible w/surrounding landuse	•Elimination of MWRA floating dock on eastern edge of site. •Restriction of ship to shore transfer of people and freight
TRAFFIC	•Transport sediments by barge (approx. 100 barge trips) •No truck traffic impacts	•Transport sediments by barge (approx. 70 barge trips) •No truck traffic impacts	•Transport sediments by barge (approx. 100 barge trips) •No truck traffic impacts	•Transport sediments by barge (approx. 80 barge trips) •No truck traffic impacts	•Transport sediments by barge (approx. 130 barge trips) •No truck traffic impacts	•Transport sediments by barge (approx. 90 barge trips) •No truck traffic impacts

TABLE (3-10(CONTINUED). IMPACTS CAUSED BY USING SPECIFIC AQUATIC SHORELINE SITES FOR BOSTON HARBOR DREDGED MATERIAL DISPOSAL.

RESOURCE	CABOT PAINT		LITTLE MYSTIC CHANNEL	RESERVED CHANNEL	
	TOTAL FILL	PARTIAL FILL		AREA A	AREA B (WEST END)
SITE DESIGN	Bulkhead harbor face; fill behind silt curtain/weir to MHW or higher. Footprint=5.8 ac; capacity=198,000 cu. yds.	Bulkhead harbor face; fill behind silt curtain/weir to-0 ft MLW, cap with sand to MLW. Footprint= 5.8 ac.; capacity=18,000 cu. yds.	Bulkhead river face; fill behind silt curtain/weir to -3 ft MLW, cap 3 ft thick with sand to MLW. Footprint-15 ac.; capacity-303,000 cu. yds.	Bulkhead near Summer St. Bridge, west of marina. Fill to -8 ft MLW, Cap; Cut bulkhead, Footprint=8.9 ac capacity=14,000 cy	Bulkhead westernmost end; Fill to 8.5 ft MLW, Cap to MHW; Removs bulkhead; Saltmarsh Footprint=7.7 ac Capacity=186,000
WATER QUALITY	•Permanent loss of 33 million gallons of Boston Harbor capacity •Dewatering controls needed.	•Permanent loss of 12 million gallons of Boston Harbor capacity •Dewatering controls needed.	•One CSO and six discharge pipes may need to be diverted •Siltation controls needed.	•Perm. loss of 48.5 million gallons of Boston Harbor Capacity, no impact on current velocity •Siltation controls needed.	•Perm. loss of 16 million gallons of Boston Harbor Capacity •3 CSO's should need to be relocated •Siltation controls needed.
MARINE INTERTIDAL	•Perm. loss of Fucus & barnacle production on hard substrate •Permanent loss of gravel beaches on northeast and northwest	Permanent loss of gravel beaches on northeast and northwest	•Temporary reduction in Fucus, green algae and barnacle production on hard substrate •Short-term impact on small sandy-gravel beach	Temporary reduction in Fucus, green algae and barnacle production on hard substrate	•Perm. loss of barnacle, Fucus, green algae and barnacle prod. on hard sub. •Perm. loss of small rocky beach •Increase in intertidal habitat •Increase primary prod. (saltmarsh)
MARINE SUBTIDAL	Permanent loss of 5.8 acres fine-grained soft habitat	•Alteration of 5.8 ac. of soft substrate. •Improve sediment quality	•Conversion to shallow subtidal habitat •Improve sediment quality •Temporary loss of 15.0 acres of soft substrate	•Conversion to shallow subtidal habitat •Improve sediment quality •Temporary loss of 8.9 acres of soft substrate	•Conversion to shallow subtidal habitat, then to salt marsh •Permanent loss of 7.7 ac. of soft substrate
SHELLFISH	None		Short-term impacts on mussels and metal bulkhead	None	
FINFISH	•Mortality of demersal fish eggs; larvae and adults trapped behind bulkhead. •Permanent loss of finfish refuge and foraging habitat	•Mortality of demersal fish eggs; larvae and adults trapped behind bulkhead. •Temporary loss of finfish refuge and foraging habitat	•Short-term mortality of fish eggs; larvae and adults trapped behind bulkhead. •Temporary reduction on prey available to species which feed primarily on benthic invertebrate •Temporary loss of finfish refuge and foraging habitat		•Mortality of fish eggs; larvae and adults trapped behind bulkhead. •Temporary loss of finfish refuge and foraging habitat
FRESHWATER AQUATIC RESOURCES	Not applicable				
WETLAND VEGETATION, WILDLIFE	Permanent loss of 5.8 acres of intertidal and subtidal wetlands	Alteration of 5.8 acres of intertidal and subtidal wetlands	Temporary impact of 15 ac. of subtidal wetlands	Temporary loss of 8.9 ac. of subtidal wetlands	Temporary loss of 7.7 ac. of intertidal and subtidal wetlands
THREATENED & ENDANGERED SPECIES	None				
HISTORIC & ARCHEOLOGICAL	None				
SOCIOECONOMIC & LANDUSE	•Conversion of aquatic habitat to fastland.	None	None	Possible conflict with yacht club	
TRAFFIC	•Transport sediments by barge (approx. 70 barge trips) •No truck traffic impacts	•Transport sediments by barge (approx. 15 barge trips)	•Transport sediments by barge (approx. 170-220 barge trips or 11,700 - 15,200 truck trips)	•Sediment by barges (140) and trucks (9800): minor delays to commercial/recreational boating traffic. •Some roadway traffic delays and noise impacts	

TABLE 3-11. POTENTIAL IMPACTS CAUSED BY USING SPECIFIC SUBAQUEOUS, BORROW PIT AND IN-CHANNEL SITES FOR BOSTON HARBOR DREDGED MATERIAL DISPOSAL.

RESOURCE	SUBAQUEOUS B	SUBAQUEOUS E	WINTHROP HARBOR	CHELSEA CREEK IN-CHANNEL	INNER CONFLUENCE IN-CHANNEL
SITE DESIGN	Place silt and cap with sand to final depth of -15 ft MLW. Footprint=82 ac. Capacity=up to 562,000	Place silt and cap with sand to final depth of -8 ft MLW. Footprint=79 acres Capacity=up to 591,000	Place silt and cap with sand to final depth of -12 ft MLW. Footprint=8 acres Capacity=167,000 cy	•Over dredge channel to -55 ft MLW •Fill to 42 ft MLW with contaminated sediments •Cap to -40 ft MLW with sand •Capacity=332,000cy	•Over dredge channel to -50 ft MLW •Fill to -44 ft MLW with contaminated sediments •Cap to -42 ft MLW with sand •Capacity=240,000 cy
WATER QUALITY	•Potential for water quality exceedences after 4 hrs up to 4500 ft from dump site. •Permanent loss of up to 204 million gal. of Boston Harbor water capacity	•Potential for water quality exceedences after 4 hrs up to 4500 ft from dump site. •Permanent loss of up to 201 million gal. of Boston Harbor water capacity	•Potential for water quality exceedences after 4 hrs up to 4500 ft from dump site. •Permanent loss of up to 64.8 million gal. of Boston Harbor water capacity	•Potential for water quality exceedences after 4 hrs up to 4500 ft from dump site •Negligible effect on current velocity •No change in Harbor volume	•Potential for water quality exceedences after 4 hrs up to 4500 ft from dump site •Negligible effect on current velocity •No change in Harbor volume
MARINE INTERTIDAL	Not applicable				
MARINE SUBTIDAL	Temporary loss of up to 83 ac. of soft substrate	Temporary loss of up to 79 ac. of soft substrate	•Temporary loss of up to 8.14 ac. of soft substrate •Improved habitat quality for benthic fauna	No habitat loss beyond that caused by improvement dredging project.	
SHELLFISH	Short-term impact on softshell clam and lobster populations due to increased suspended sediments		Short-term impact on softshell clam population due to increased suspended sediments	Potential short-term impacts to nearby resources due to impacts to water quality, although no commercial beds nearby.	
FINFISH	• Short-term mortality of fish eggs, larvae, and adults • Temporary reduction of prey available to species which feed primarily on invertebrates • Temporary interference with commercial fishery				
FRESHWATER AQUATIC RESOURCES	Not applicable				
WETLAND VEGETATION, WILDLIFE	Temporary impact on 83 ac. of subtidal wetland	Temporary impact on 79 ac. of subtidal wetland	Temporary loss of 8.14 ac. of subtidal wetland	No impacts beyond those incurred due to dredging project	
THREATENED & ENDANGERED SPECIES	• None aspected				
HISTORIC & ARCHEOLOGICAL	• None				
SOCIOECONOMIC & LANDUSE	Minor temporary impact on boat traffic	Interruption of use of small vessel navigation channel	Temporary impact on boat traffic	Prolonged dredging in navigational channel resulting in additional minor interruption of shipping traffic	
TRAFFIC	•Transportation of dredged material by barge •Approx. 450 barge trips •Temporary interruptions in Dorchester Channel	•Transportation of dredged material by barge •Approx. 450 barge trips •Relocation of small vessel channel	•Transportation of dredged material by barge •Approx. 120 barge trips •Temporary interruptions in Winthrop Harbor Channel	•Addit. dredging would require 60 days •120 barge trips required to remove clay sediments	• 30 days of additional dredging • 60 barge trips to remove clay

TABLE 3-11(CONT'D). POTENTIAL IMPACTS CAUSED BY USING SPECIFIC SUBAQUEOUS, BORROW PIT AND IN-CHANNEL SITES FOR BOSTON HARBOR DREDGED MATERIAL DISPOSAL

RESOURCE	MYSTIC RIVER IN-CHANNEL	MEISBURGER 2	MEISBURGER 7	SPECTACLE ISLAND CAD
SITE DESIGN	•Over dredge to -70 ft MLW •Fill to -44 ft MLW with silt •Cap to -42 ft MLW with sand •Capacity=742,000 cy	•Dredge pit 13 ft deep •Fill with dredged silt •Cap with clay and sand to pre-existing contours •Footprint=80 acres •Capacity=1,320,000 cy	•Dredge pit 10 ft deep •Fill with dredged silt •Cap with clay and sand to pre-existing contours •Footprint=121 acres •Capacity=1,320,000 cy	•Dredge existing sediments to -31 ft MLW •Fill with dredged silt •Cap with clay and sand to pre-existing contours •Footprint=20-50 acres •Capacity=1,320,000 cy
WATER QUALITY	•Potential for water quality exceedences after 4 hrs up to 4500 ft from dump site •No change in Harbor volumes	Water quality criteria not exceeded outside site 4 hrs after dump.	Water quality criteria not exceeded outside site 4 hrs after dump.	Potential for water quality exceedences; Construction/mitigation steps would be planned
MARINE INTERTIDAL	Not applicable			
MARINE SUBTIDAL	No habitat loss beyond that caused by improvement dredging project	•Temporary loss of 150 ac. of soft substrate •Beach improvement from excavated material	•Temporary loss of 82-403 ac. of soft substrate •Beach improvement from excavated material	Temporary lose of 20-70 ac. of soft substrate
SHELLFISH	Potential short-term impacts to nearby resources due to impacts to water quality	•Short-term impact on lobster population •Temporary interference with commercial fishery		Potential temporary siltation on nearby mussel beds
FINFISH	•short-term mortality of fish eggs, larvae and adults •Temporary reduction of prey available to species which feed primarily on invertebrates •Temporary interference with commercial fishery			
FRESHWATER AQUATIC RESOURCES	Not applicable			
WETLAND VEGETATION, WILDLIFE	No impacts beyond those incurred due to dredging project	•No state jurisdictional wetlands (>80 ft MLW) •Temporary interference with commercial fishery		Temporary loss of 22 ac. of subtidal wetlands
THREATENED & ENDANGERED SPECIES	None expected	None expected, although some species of whales and sea turtles could occur in area incidentally		Not applicable
HISTORIC & ARCHEOLOGICAL	None			
SOCIOECONOMIC & LANDUSE	Prolonged dredging in navigational channel resulting in additional minor interruption of shipping traffic	Temporary impact on fishing and recreational boating		•Temporary impact on recreational boating •Possible conflict with construction of fish reef
TRAFFIC	•90 days of additional dredging •185 barge trips to remove parent material	•Dredge will be on site for > 1 year •660 barge trips required to remove sediments •660 barge trips required to transport harbor sediments to site	•Dredge will be on-site for > 1 year •660 barge trips required to remove sediments •660 barge trips required to transport harbor sediments to site	•Dredge will be on site for> 9 months •660 barge trips required to remove sediments •660 barge trips required to transport harbor sediments to site

TABLE 3-12. IMPACTS CAUSED BY USING EXISTING OPEN WATER DISPOSAL SITES FOR BOSTON HARBOR DREDGED MATERIAL DISPOSAL.

RESOURCE	MASSACHUSETTS BAY DISPOSAL SITE	BOSTON LIGHTSHIP
SITE DESIGN	Continuous point disposal of silt two weeks after start of dredging; Capping with parent material.	
WATER QUALITY	No water quality criteria exceedances after four hours outside the site.	
MARINE INTERTIDAL	Not applicable	
MARINE SUBTIDAL	•Benthic resources maintained in pioneering stage due to regular disposal •No significant change from existing conditions	Possible mature benthic community now existing, Disposal would temporarily convert to a pioneering community.
SHELLFISH	Gills of any shellfish in immediate vicinity of disposal site could become clogged	
FINFISH	•Some mortality of demersal fish due to burial •Avoidance of disposal operation	
FRESHWATER AQUATIC RESOURCES	Not applicable	
WETLAND VEGETATION, WILDLIFE	Designated disposal site	Alteration of subtidal habitat conditions in Tidal Waters
THREATENED & ENDANGERED SPECIES	•Endangered whales and turtles are transients in area, and would likely avoid disposal activities	
HISTORIC & ARCHEOLOGICAL	None	Needs further review
SOCIOECONOMIC & LANDUSE	•Designated dredged material disposal site •No change in current use	Former dredged material disposal site
TRAFFIC	•Disposal of parent material and rock would require up to 500 barge trips (4000 cy capacity) •Disposal of silt would require up to 170 barge trips (4000 cy capacity) •Average of two barge trips per day	

TABLE 3-13. ALTERNATIVE DIPSOSAL OPTIONS FOR DISPOSAL OF SILT SEDIMENTS

SITE TYPE	SITE	CAPACITY (CY)	COST	DISPOSAL OPTION
UPLAND				
Landfill	E. Bridgewater	200 daily cover, 200 fill in cy/day	$62	A1, A2, C1, C3
	Plainville	50 daily cover, 250 fill in cy/day	$94	A1, A2, C1, C3
	Fitchberg/ Westminster	75 daily cover, 250 fill in cy/day	$108	A1, A2, C1, C3
Inland	Woburn	158,600	$69	A2, A3, C2, C4
	Wrentham	451,200	$62	A2, A3, C2, C4
Coastal	Everett	37,000	$76	A2, C2, C4
	Squantum Pt.	210,000	$44-$51	A2, A3, C2, C4
AQUATIC				
Shoreline	Amstar	128,000 MLW, 241,000 MHW	$62-$50	B1, B5, C1, C2
	Cabot Paint	18,000 MLW, 198,000 MHW	$362-$66	B1, B5, C1, C2
	Lt. Mystic Channel	303,000 to -3 ft. MLW	$47	B1, B5, C1, C2
	Mystic Piers	98,000 MLW, 187,000 MHW	$47-$38	B1, B5, C1, C2
	Reserved A	14,000 MLW, 390,000 MHW	$341-$44	B1, B5, C1, C2
	Reserved B	186,000 MLW, 315,000 MHW	$45-$40	B1, B5, C1, C2
	Revere Sugar	86,000 MLW, 204,000 MHW	$93-$61	B1, B5, C1, C2
Subaqueous	Sub. B	562,000	$20	B2, B5, C3, C4
	Sub. E	591,000	$19	B2, B5, C3, C4
In-Channel	Chelsea	332,000	$30	B3, B5, C3, C4
	Mystic	742,000	$30	B3, B5, C3, C4
	Inner Confl.	246,000	$30	B3, B5, C3, C4
Borrow Pit	Meisburger 2	1,320,000	$30	B4, B5, C3, C4
	Meisburger 7	1,320,000	$33	B4, B5, C3, C4
	Spec. Isl. CAD	1,320,000	$21	B4, B5, C3, C4
Existing Sites	Boston Lt. Ship	1,320,000	$16	D1, D2
	MBDS	1,320,000	$27	D1, D2
TREATMENT	Solidification	6,000 per day	$55	D1

TABLE 3-14. COST ESTIMATES FOR LANDFILL SITES FOR BINIP SILT DISPOSAL

Landfills

Location	Distance (miles)	Silt Volume (CY)	Dredging Cost $8.29	Dewatering Cost $17.00	Hauling Cost/CY	Hauling Cost	Tipping Fee ($/CY)	Tipping Cost	Total Cost	Unit Cost for Silt ($/CY)
East Bridgewater	25	200,000	$1,658,000	$3,400,000	$9.20	$1,840,000	$28	$5,600,000	$12,498,000	$62.00
Plainville	35	200,000	$1,658,000	$3,400,000	$12.25	$2,450,000	$56	$11,200,000	$18,708,000	$94.00
Fitchburg/Westminster	45	200,000	$1,658,000	$3,400,000	$12.25	$2,450,000	$70	$14,000,000	$21,508,000	$108.00

ASSUMPTIONS

Silt volume includes disposal and possible contour capping.
Hauling costs assumed fleet of 20 trucks and 3 loaders working 5 days per week.
Dewatering cost based on combined use of air drying and belt filter press and includes land rental.

TABLE 3-15 COST ESTIMATES FOR LAND-BASED SITES FOR BHNIP SILT DISPOSAL

Woburn-11

Footprint (Sq Ft)	Perimeter (FT)	Dike Material (CY)	Dike Cost $15.00 /CY	Lining Cost $26.00 /SY	Road Fill $13.00 /CY	Clearing/ Drainage
617,500	3,100	63,400	$951,000	$1,753,889	$1,560,000	$59,200

Silt Volume (CY)	Dredging Cost $8.29 /CY	Hauling Cost $9.30 /CY	Cap Cost $15.00 /CY	Dewatering Cost $17.00 /CY	Treatment Cost $2.00 /CY
158,600	$1,314,794	$1,474,980	$525,000	$2,696,200	$317,200

	Land Cost	Total Cost	Unit Cost for Silt
	$212,638	$10,695,000	$68.69

ASSUMPTIONS

Footprint (area) planimetered from quad sheet.
Footprint selected to avoid wetlands and power lines. As a result two of three areas were not large enough to use
Dike volume computed from dike height of 12', top width of 10' and side slopes of 1V to 3H ("CAD CELL" program).
Sediment thickness 10' with 2' cap thickness.
Liner consists of geomembrane for positive cut-off, 1' of sand and a geotextile filter
Also included in cost of liner is a geotextile filter at the cap layer
Sand cost $12/CY, geotextile $3/SY and geomembrane $16/SY
Volume of road fill calculated for road within the diked area requiring 120,000 CY
Clearing costs determined by assuming $2600/acre for 14 acres.
Drainage costs assumed to be rerouting local drainage @ $20,000
Hauling costs assumed fleet of 30 trucks and 4 loaders working 7 days/wk for 3 months
Cap was assumed to be trucked from Boston (Boston Blue Clay from Improvement Project).
Dewatering cost based on combined use of air drying and belt filter press and includes land rental.
Treatment of leachate from site is expected to require saline tainted water to be reexported
to a local treatment plant, construction of package treatment plant or trucking to the ocean.
Dewatering site rental calculated @ $1.57/SF

TABLE 3-15 (CONTINUED). COST ESTIMATES FOR LAND-BASED SITES FOR DISPOSAL OF BHNP SILTS

Wrentham-485

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Footprint (Sq Ft)	Perimeter (FT)	Dike Material (CY)	Dike Cost	Lining Cost	Road Fill	Clearing/ Drainage
			$11.00 /CY	$26.00 /SY	$13.00 /CY	
1,524,600	6,185	91,200	$1,003,200	$4,404,400	$1,950,000	$188,000

Silt Volume (CY)	Dredging Cost $6.29 /CY	Hauling Cost $12.00 /CY	Cap Cost $11.00 /CY	Dewatering Cost /CY $17.00	Treatment Cost /CY $2.00
451,200	$3,740,448	$5,414,400	$1,977,600	$7,670,400	$902,400

	Land Cost	Total Cost	Unit Cost for Silt
	$525,000	$27,776,000	$61.56

ASSUMPTIONS

Footprint (area) planimetered from quad sheet and added for two separate diked areas
Footprint selected to avoid wetlands, power lines and residential areas
Dike volume computed from dike height of 12', top width of 10', side slopes of 1V to 3H ("CAD CELL" program)
Sediment thickness 10' with 2' cap thickness.
Liner consists of geomembrane for positive cut-off, 1' of sand and a geotextile filter
Also included in cost of liner is a geotextile filter at the cap layer
Sand cost $1/2CY, geotextile $3/SY and geomembrane $16/SY
Volume of road fill calculated for road within the diked area requiring 150,000 CY
Clearing costs determined by assuming $2500/acre for 60 acres
Drainage costs assumed to be rerouting local drainage @ $20,000
Hauling costs assumed fleet of 30 trucks and 4 loaders working 7 days/wk for 15 months
Cap was assumed to be purchased locally with volume of 96,000 CY determined from "CAD CELL" program
Dewatering cost based on combined use of air drying and belt filter press and includes land rental.
Treatment of leachate from site is expected to require saline tainted water to be transported
to a local treatment plant, construction of package treatment plant or trucking to the ocean
Dewatering site rental calculated @ $1.57/SF
Land cost calculated @ $15,000/Ac

TABLE 3-15 (CONTINUED). COST ESTIMATES FOR LAND-BASED SITES FOR DISPOSAL OF BHNP SILTS

UPLAND

Squantum - (Trucking)

Footprint (Sq Ft)	Perimeter (FT)	Dike Material (CY)	Dike Cost $15.00 /CY	Clearing/ Drainage
782,500	4,300	87,900	$1,318,500	$45,200

Silt Volume (CY)	2' Cap Volume (CY)	Total Volume (CY)	Dredging Cost $8.29 /CY Silt $7.76 /CY Parent	Hauling Cost/CY $5.00
210,000	46,000	256,000	$2,097,860	$1,280,000

Dewatering Cost $17.00 /CY	Road Fill $13.00 /CY	Land Cost	Total Cost	Unit Cost for Silt
	$650,000	$269,456	$9,231,000	$43.96
$3,570,000				

Squantum - (Barging)

Footprint (Sq Ft)	Perimeter (FT)	Dike Material (CY)	Dike Cost $15.00 /CY	Clearing/ Drainage
782,500	4,300	87,900	$1,318,500	$45,200

Silt Volume (CY)	2' Cap Volume (CY)	Total Volume (CY)	Dredging Cost $8.29 /CY Silt $7.76 /CY Parent	Land Cost
210,000	46,000	256,000	$2,097,860	$269,456

Dredging Access (CY)	Dredging Access $8.50 /CY	Rehandling Cost $15.00	Total Cost	Unit Cost for Silt
160,000	$1,360,000	$5,550,000	$10,641,000	$50.67

ASSUMPTIONS

Footprint (area) planimetered from quad sheet.
Footprint selected to avoid wetland
Dike volume computed from dike height of 12', top width of 10' and side slopes of 1V to 3H time perimeter of 4300'
Sediment thickness 10' with 2' cap thickness
Cleaning costs determined by assuming $1400/acre for 18 acres
Drainage costs assumed to be rerouting local drainage @ $20,000
Hauling costs assumed fleet of 10 trucks and 3 loaders working 7 days/wk for 4.5 months
Dewatering cost based on combined use of air drying and belt filter press and includes land rental
Volume of road fill calculated for road within the diked area requiring 50000 CY
The 2700' x 175' access channel assumed to have existing depth of -4 MLW and require a 12' depth
Rehandling cost is for a barge-mounted crane to unload silt scows.
Dredging costs - parent = $7.76, silt = $8.29
Dewatering site rental calculated @ $1.57/SF and land cost calculated @ $15,000/Ac

TABLE 3-15 (CONTINUED). COST ESTIMATES FOR LAND-BASED SITES FOR BHNIP SILT DISPOSAL

Everett-04

Silt Volume (CY)	2' Cap Volume (CY)	Total Volume (CY)	Mechanical Dredging Cost/CY	Rehandling Cost/CY	Total Dredging Cost	Bulkhead (LF)	Depth of Piles (FT)	Bulkhead Cost ($30/SF)
37,000	18,000	55,000	$8.29 Silt $7.76 Parent	$15.00	$1,271,410	400	105	$1,260,000

Dike (CY)	Dike Cost $16.00 /CY	Footprint Area (SQ FT)	Average Depth (FT)	Wier/Silt Curtain Cost	Total Cost	Unit Cost for Silt ($/CY)
17,100	$256,500	243,936	8	$36,590	$2,824,500	$76.34

ASSUMPTIONS

Footprint (area) planimetered from quad sheet.
Footprint selected to avoid crossing municipal boundary.
Dike volume computed from dike height of 8', top width of 10' and side slopes of 1V to 3H.
Dike length 1700'.
Sediment thickness varies (assumed to be 8') with cap thickness of 2'.
Volumes shown are dredged volumes (expansion of dredged material has not been applied).
Rehanding cost is for a barge-mounted crane to unload the scows.
Bulkhead costs reflect $30/SF for steel.
Bulkhead assumed to tie to fast ground and only be necessary along fronting water edge.
Wier required and is based on cost of $0.15/CY of material contained.
Dredge costs - parent = $7.76, silt = $8.29.

TABLE 3-16. COST ESTIMATES FOR AQUATIC SHORELINE OPTIONS

	Fill to level of: (MLW)	Volume: Sediment Volume (CY)	Volume: 3' Cap Volume (CY)	Volume: Total Volume (CY)	Surface Footprint (SQ FT)	Depth (FT)	Capacity/ Ft Depth (CY)	Concrete Panel Bulkhead: Bulkhead (LF)	Concrete Panel Bulkhead: Depth of Piles (FT)	Concrete Panel Bulkhead: Panel Cost ($4/SQ FT)	Concrete Panel Bulkhead: Steel H-piles ($88/LF)
Revere Sugar	20	204,000	18,000	222,000	160,000	37.5	6,000	1545	125	$339,900	$2,051,053
Amstar	20	241,000	17,000	258,000	153,000	45.5	6,000	1065	125	$234,300	$1,414,453
Mystic Piers	20	187,000	13,000	200,000	120,000	45	4,000	195	125	$42,900	$258,984
Cabot Paint	20	198,000	27,000	225,000	243,000	25	9,000	1605	125	$353,100	$2,131,841
Little Mystic Channel	20	840,000	70,000	910,000	630,000	39	23,000	360	125	$79,200	$478,125
Reserved Channel A	20	390,000	43,000	433,000	390,000	30	14,000	825	110	$181,500	$964,219
Reserved Channel B	20	315,000	38,000	353,000	334,000	28.5	12,000	225	110	$40,500	$262,089

	Dredging/Handling: Dredging Cost/CY (silt)	Dredging/Handling: Dredging Cost/CY (peraml)	Dredging/Handling: Rehandling Cost/CY	Dredging/Handling: Total Dredging Cost	Tie-Backs: Three Rows Cost/row ($220/LF)	Geotextile/Drainage Quantities: Fabric (SY)	Geotextile/Drainage Quantities: Sand Filter (CY)	Geotextile/Drainage Quantities: T-drains (EA)
Revere Sugar	$8.29	$7.76	$15.00	$5,180,840	$1,019,700	24,215	11,852	77
Amstar	$8.29	$7.76	$15.00	$5,999,810	$702,900	22,384	11,333	63
Mystic Piers	$8.29	$7.76	$15.00	$4,651,110	$128,700	14,308	8,889	10
Cabot Paint	$8.29	$7.76	$15.00	$5,225,940	$1,056,300	31,458	16,000	80
Little Mystic Channel	$8.29	$7.76	$15.00	$21,156,600	$237,600	71,560	46,667	18
Reserved Channel A	$8.29	$7.76	$15.00	$10,061,760	$544,500	48,083	28,889	41
Reserved Channel B	$8.29	$7.76	$15.00	$8,201,230	$148,500	37,824	24,741	11

	Wier/Silt Curtain Cost	Design and Const. Mgt Cost (26%)	Contingency Cost (26%)	Total Cost	Unit Cost for Silt ($/CY)	Geotextile/Drainage Costs: Fabric ($7/SY)	Geotextile/Drainage Costs: Sand Filter ($13/CY)	Geotextile/Drainage Costs: T-drains ($660/EA)	Geotextile/Drainage Costs: S'head Labor ($4/SF)
Revere Sugar	$24,000	$854,000	$2,499,000	$12,498,630	$61.26	$169,507	$154,074	$43,260	$380,396
Amstar	$22,950	$828,000	$2,400,000	$11,998,470	$46.75	$156,686	$147,333	$29,920	$252,215
Mystic Piers	$18,000	$376,000	$1,436,000	$7,180,676	$38.40	$100,156	$115,556	$5,460	$48,011
Cabot Paint	$36,450	$879,000	$2,595,000	$12,974,748	$65.53	$220,206	$234,000	$44,940	$395,186
Little Mystic Channel	$94,500	$1,828,000	$6,220,000	$31,100,528	$37.02	$500,920	$606,667	$10,080	$88,636
Reserved Channel A	$39,500	$891,000	$3,406,000	$17,031,662	$43.67	$322,583	$375,556	$23,100	$203,124
Reserved Channel B	$50,100	$855,000	$2,504,000	$12,519,391	$39.74	$264,765	$321,630	$6,300	$55,387

ASSUMPTIONS

Volumes shown are dredged volumes (expansion of dredged material has not been applied).
Surface area planimetered from navigation chart vertical sides assumed.
Depth is an average as shown on navigation chart or recent survey.
Dredging cost is not dependent on distance to disposal site.
Bulkhead assumed to tie to fast ground and may be necessary along several sides.
Wier required if disposal site to create fast land (cost is $0.15 x surface area).
Rehandling includes floating crane plus repositioning of material in the site.

Bulkhead design source: J. Fowler & NY District MOTB.
T-drains thru bulkhead every 20' extend into filter.
Sand filter laid on top of fabric in 2' layer.
Fabric placed on bottom and sides.
Concrete panels fitted between H-piles @ 384 SF/day
H-piles spaced 8' apart.
Tie-backs assumed to run length of bulkhead.
Labor costs for divers, crane and laborers @ $1720/day.

TABLE 3-16. (CONTINUED) ESTIMATES FOR AQUATIC SHORELINE OPTIONS TO MLW

	Fill to level of: (MLW)	Volume: Sediment Volume (CY)	Volume: 3' Cap Volume (CY)	Volume: Total Volume (CY)	Surface Footprint (SQ FT)	Depth (FT)	Capacity/ Ft Depth (CY)	Concrete Panel Bulkhead: Bulkhead (LF)	Concrete Panel Bulkhead: Depth of Piles (FT)	Concrete Panel Bulkhead: Panel Cost ($4/SQ FT)	Concrete Panel Bulkhead: Steel H-piles ($86/LF)
Revere Sugar	0	88,000	16,000	104,000	180,000	17.5	6,000				
Amstar	0	128,000	17,000	145,000	183,000	25.5	8,000	1545	105	$216,305	$1,723,841
Mystic Piers	0	98,000	13,000	111,000	120,000	28	4,000	1065	105	$149,100	$1,166,141
Cabot Paint	0	18,000	27,000	45,000	243,000	5	8,000	195	105	$27,300	$217,547
Little Mystic Channel	-3	303,000	70,000	373,000	830,000	16	23,000	1605	105	$224,700	$1,790,378
Reserved Channel A	-6	14,000	44,000	58,000	390,000	4	14,000	380	102	$46,080	$390,180
Reserved Channel B	9.5	186,000	37,000	223,000	334,000	16	12,000	825	84	$95,700	$736,313
								225	99.5	$40,050	$237,897

	Dredging/Handling: Dredging Cost/CY (silt)	Dredging/Handling: Dredging Cost/CY (parent)	Dredging/Handling: Rehandling Cost/CY	Dredging/Handling: Total Dredging Cost	Tie-Backs: Three Rows Cost/row ($220/LF)	Geotextile/Drainage Quantities: Fabric (SY)	Geotextile/Drainage Quantities: Sand Filter (CY)	Geotextile/Drainage Quantities: T-drains (EA)	Bulkhead Cost: Bulkhead (LF)	Bulkhead Cost: Depth of Piles (FT)	Bulkhead Cost: Bulkhead Cost ($30/SQ FT)
Revere Sugar	$8.29	$7.76	$15.00	$2,412,820	$1,019,700	20,782	11,852	77	155	105	$519,750
Amstar	$8.29	$7.76	$16.00	$3,388,040	$702,900	20,018	11,333	63	378	105	$1,181,250
Mystic Piers	$8.29	$7.76	$15.00	$2,575,300	$126,700	13,875	8,689	10	225	105	$706,750
Cabot Paint	$8.29	$7.76	$15.00	$1,033,740	$1,059,300	27,892	16,000	80	930	105	$2,929,500
Little Mystic Channel	$8.29	$7.76	$15.00	$8,650,070	$237,600	70,840	46,867	18	360	102	$1,101,900
Reserved Channel A	$8.29	$7.76	$15.00	$1,327,500	$544,500	43,700	28,889	41	555	84	$1,474,200
Reserved Channel B	$8.29	$7.76	$15.00	$5,174,060	$146,300	37,961	24,741	11	585	99.5	$1,746,225

	Wier/Silt Curtain Cost	Design and Const. Mgt Cost	Contingency Cost (25%)	Total Cost	Unit Cost for Silt ($/CY)	Geotextile/Drainage Costs: Fabric ($7/SY)	Geotextile/Drainage Costs: Sand Filter ($13/CY)	Geotextile/Drainage Costs: T-drains ($560/EA)	Geotextile/Drainage Costs: B'head Labor ($4/SF)
Revere Sugar	$24,000	$419,000	$1,600,000	$8,000,136	$93.02	$145,474	$154,074	$43,260	$242,070
Amstar	$22,950	$414,000	$1,582,000	$7,911,270	$81.81	$140,123	$147,333	$20,920	$166,864
Mystic Piers	$16,000	$225,000	$861,000	$4,304,545	$43.92	$97,125	$115,556	$5,460	$30,553
Cabot Paint	$38,450	$341,000	$1,303,000	$8,514,421	$361.91	$195,242	$234,000	$44,940	$251,471
Little Mystic Channel	$64,600	$741,000	$2,831,000	$14,163,197	$46.71	$464,480	$608,667	$10,080	$51,570
Reserved Channel A	$56,500	$250,000	$956,000	$4,780,170	$341.44	$305,900	$375,556	$23,100	$107,102
Reserved Channel B	$50,100	$440,000	$1,682,000	$8,408,268	$45.21	$262,928	$321,630	$8,360	$44,622

ASSUMPTIONS

Volumes shown are dredged volumes (expansion of dredged material has not been applied).
Surface area planimetered from navigation chart vertical sides assumed.
Depth is an average as shown on navigation chart or recent survey.
Dredging cost is not dependent on distance to disposal site.
Bulkhead assumed to tie to fast ground and may be necessary along several sides.
Wier required if disposal site to create fast land (cost is $0.15 x surface area).
Rehandling includes floating crane plus repositioning of material in the site.

Bulkhead design source: J. Fowler & NY District MOTB.
T-drains thru bulkhead every 20' extend into filter.
Sand filter laid on top of fabric in 2' layer.
Fabric placed on bottom and sides.
Concrete panels fitted between H-piles @ 364 SF/day.
H-piles spaced 5' apart.
Tie-backs assumed to run length of bulkhead.
Labor costs for divers, crane and laborers @ $1720/day.

TABLE 3-17. COST ESTIMATE FOR SUBAQUEOUS DEPRESSION OPTION FOR BHNIP SILT DISPOSAL

Subequeous S

	Footprint Perimeter (Sq Ft)	(FT)	Fill to Depth Below MLW (FT)	Existing to Depth Below MLW (FT)	Volume: Silt Volume (CY)	Volume: 3' Cap Volume (CY)	Volume: Total Silt/Cap (CY)	Volume: Closure Dike (CY)
	Length=>	1250						
	Width=>	2000						
(North)	2,500,000	6,500	15	21	266,109	274,539	542,649	130,000
	Length=>	900						
	Width=>	1200						
(South)	1,080,000	4,200	15	28	284,440	117,912	412,352	255,800

		Costs: Parent Material (CY)	Dredging Cost	Design and Constr. Mgt Cost (7%)	Contingency Cost (26%)	Total Cost Silt	Unit Cost for Silt ($/CY)	
(North)			$1,867,829	$181,090	$507,000	$2,535,829	$11.35	
							($11.34)	w/no cap
(South)			$2,051,284	$174,000	$556,000	$2,781,284	$11.34	
	Parent for Dike =	365,800	$2,384,576	$168,000	$641,000	$3,203,576		
							$19.71	w/sand cap
	Parent for Cap but to MBDS =	392,451	$3,045,422	$213,000	$815,000	$4,073,422		
	Send for Cap =		$3,924,513	$275,000	$1,050,000	$5,249,513		
	Parent to MBDS =	(60,000)	($465,600)	($33,000)	($125,000)	($623,600)	<= See note 1	
					(Portion)	$3,019,284	Rock	
						$14,989,754		
						$20,239,287	w/sand cap	

Note 1: There is a shortfall of parent material if this site used alone.
The negative cost when combined with Sub-E cancels a portion of
the 250,000 cy parent material shown being sent to MBDS.

ASSUMPTIONS

Footprint (area) planimetered from navigation chart.
Existing depth calculated from navigation chart soundings within area.
Fill depth is finished depth including a 3 foot cap.
Design effort involves minimal site hydrographic survey ($20,000) and benthic and fish studies ($10,000).
Dredging costs - silt = $8.39, parent = $7.76, cap = $6.21, dike = $6.21.
Cap and dike both consist of parent material.
Parent material to MBDS is ratio of silt/(total silt) x total parent.

Subaqueous E

TABLE 3-17 (CONTINUED). COST ESTIMATE FOR SUBAQUEOUS DPRESSION OPTION FOR BHNIP SILT DISPOSAL

Footprint (Sq Ft)	Perimeter (FT)	Fill Depth Below MLW (FT)	Existing to Depth Below MLW (FT)	Volume: Silt Volume (CY)	Volume: 3' Cap Volume (CY)	Volume: Total Silt/Cap (CY)	Volume: Closure Dike (CY)
Length=>	850						
Width=>	4100						
3,485,000	9,900	8	15.8	591,164	382,280	973,444	62,200

	Costs: Parent Material (CY)	Dredging Cost	Design and Constr. Mgt Cost (7%)	Contingency Cost (28%)	Total Cost Silt	Unit Cost for Silt ($/CY)
		$4,128,298	$319,000	$1,112,000	$5,559,298	$19.34 w/sand cap
Parant for Dike =	62,200	$387,506	$27,000	$104,000	$518,506	
Parant for Cap but to MBDS =	382,280	$2,968,490	$208,000	$794,000	$3,968,490	$11.28 w/no cap
Send for Cap =		$3,822,796	$268,000	$1,023,000	$5,113,796	
Parent to MBDS =	310,000	$2,405,600	$168,000	$643,000	$3,216,600	
				(Portion)	$3,172,845	Rock
					$16,435,739	
					$21,549,535	w/sand cap

ASSUMPTIONS

Footprint (area) planimetered from navigation chart.
Existing depth calculated from navigation chart soundings within area.
Fill depth is finished depth including a 3 foot cap.
Design effort involves minimal site hydrographic survey ($20,000) and benthic and fish studies ($10,000).
Dredging costs - silt = $8.38, parant = $7.78, cap = $8.23, dike = $8.23
Cap and dike both consist of parent material.
Parent material to MBDS is ratio of silt/(total silt) x total parent.

TABLE 3-18. COST ESTIMATE FOR IN-CHANNEL DISPOSAL OPTIONS FOR BHNP SILT

IN-CHANNEL

	Cell size	Cell Depth	Number of Cells	Silt Removed per cell	Parent Removed per cell	Extra Parent Removed per cell	$'Cap Required per cell	Silt Capacity per cell	Volume: Total Silt Removed	Volume: Total Parent Removed	Volume: Total Extra Parent Removed	Volume: Total Silt Capacity	Volume: Cap Volume (CY)	Costs: Dredging Cost	Costs: Design and Const. Mgt Cost (7%)	Costs: Contingency Cost (25%)	Total Cost
Mystic River																	
	200x500	46	2	9,300	16,100	19,500	10,400	9,100	18,600	32,200	39,000	18,200	20,800	$857,000	$60,000	$229,000	$1,146,000
		50	1	9,300	16,000	24,900	10,400	14,500	9,300	16,000	24,900	14,500	10,400	$482,000	$32,000	$124,000	$616,000
		55	6	9,300	16,000	36,000	10,400	25,600	55,800	96,000	218,000	153,600	62,400	$3,190,000	$223,000	$853,000	$4,266,000
		56	1	9,300	16,100	37,800	10,400	27,400	9,300	16,100	37,800	27,400	10,400	$544,000	$38,000	$146,000	$728,000
		60	2	9,300	16,100	44,000	10,400	33,600	18,600	32,200	88,000	67,200	20,800	$1,186,000	$82,000	$312,000	$1,580,000
		65	7	9,300	16,100	49,400	10,400	39,000	65,100	112,700	345,800	273,000	72,800	$4,317,000	$302,000	$1,155,000	$5,774,000
		70	3	9,300	18,000	52,500	10,400	42,100	27,900	48,000	157,500	126,300	31,200	$1,908,000	$133,000	$510,000	$2,548,000
	150x500	55	1	7,300	12,300	24,900	7,700	17,200	7,300	12,300	24,900	17,200	7,700	$390,000	$27,000	$104,000	$521,000
		60	1	7,300	12,300	29,200	7,700	21,500	7,300	12,300	29,200	21,500	7,700	$417,000	$29,000	$112,000	$558,000
		70	1	7,300	12,300	30,900	7,700	23,200	7,300	12,300	30,900	23,200	7,700	$427,000	$30,000	$114,000	$571,000
Inner Confluence																	
	200x500	48	1	9,300	16,100	19,500	10,400	9,100	9,300	16,100	19,500	9,100	10,400	$429,000	$30,000	$115,000	$574,000
		55	4	9,300	16,000	36,000	10,400	25,600	37,200	64,000	144,000	102,400	41,600	$2,127,000	$149,000	$569,000	$2,845,000
		60	4	9,300	16,100	44,000	10,400	33,600	37,200	64,400	176,000	134,400	41,600	$2,331,000	$163,000	$624,000	$3,118,000
Chelsea																	
	200x500	55	3	9,300	16,000	36,000	10,400	25,600	27,900	48,000	108,000	76,800	31,200	$1,595,000	$112,000	$427,000	$2,134,000
		58	2	9,300	16,100	37,800	10,400	27,400	18,600	32,200	75,600	54,800	20,800	$1,088,000	$76,000	$291,000	$1,455,000
		59	4	9,300	16,100	41,100	10,400	30,700	37,200	64,400	164,400	122,800	41,600	$2,284,000	$158,000	$604,000	$3,020,000
		60	1	9,300	16,100	44,000	10,400	33,600	0	0	0	0	0	$0	$0	$0	$0
		65	2	9,300	16,100	49,400	10,400	39,000	18,600	32,200	98,800	78,000	20,800	$1,234,000	$86,000	$330,000	$1,650,000
	150x500	49	7	7,300	12,200	16,100	7,700	8,400	0	0	0	0	0	$0	$0	$0	$0
									412,500	711,400	1,760,300	1,320,400	459,900	$24,738,000	$1,730,000	$6,619,000	$33,087,000
							Remaining in Channel Capacity =		1 x 33600 + 7 x 8400 =			92,400					
ASSUMPTIONS							Remaining Silt to in Channel =		1099100 - 412500 =			686,600		$5,692,000	$398,000	$1,523,000	$7,813,000
	$8.29 = Unit Cost of Silt						Remaining Parent to MBDS =		1684000 - 711400 =			972,600		$7,547,000	$528,000	$2,019,000	$10,094,000
	$7.76 = Unit cost of Parent (even if used as cap)												Unit Cost for Silt				
	$8.29 = Unit cost of Extra Parent												$30.31 w/o parent			Rock	$7,081,500
	$10.00 = Unit Cost of Cap												$37.03				
	1,684,000 = Total Parent															Grand Total	$37,875,500
	1,099,100 = Total Silt																

TABLE 3-19. COST ESTIMATES FOR AQUATIC BORROW PIT OPTION FOR BHNIP SILT DISPOSAL

Melsburger 2

Footprint (Sq Ft)	Perimeter (FT)	Existing Depth Below MLW (FT)	Excavate to Depth Below MLW (FT)	Volume: Silt Volume (CY)*	Volume: 3' Cap Volume (CY)*	Volume: Total Volume (CY)	Costs: Dredging Cost	Costs: Design and Constr. Mgt Cost (7%)	Costs: Contingency Cost (25%)	Costs: Total Cost Silt	Unit Cost for Silt ($/CY)
Length=> 2000											
Width=> 1873											
3,748,000	7,746	80	83	1,319,518	412,361	1,731,879	$24,926,242	$1,775,000	$6,675,000	$33,376,242	$30.37

* Total volume of sediments and cap exceed estimated yield of sand/gravel (it is possible that yield did not account for lenses of silt)

							Costs: Dredging Cost	Costs: Design and Constr. Mgt Cost (1%)	Costs: Contingency Cost (25%)	Costs: Total Cost Parent	
		Parent to MBDS =			1,664,000		$13,067,840	$131,000	$3,300,000	$16,498,840	
										$49,875,082	
										$7,081,500	Rock
										$56,956,582	

Melsburger 7

Footprint (Sq Ft)	Perimeter (FT)	Existing Depth Below MLW (FT)	Excavate to Depth Below MLW (FT)	Volume: Silt Volume (CY)	Volume: 3' Cap Volume (CY)	Volume: Total Volume (CY)	Costs: Dredging Cost	Costs: Design and Constr. Mgt Cost (7%)	Costs: Contingency Cost (25%)	Costs: Total Cost	Unit Cost for Silt ($/CY)
Length=> 2600											
Width=> 2107											
5,267,500	9,214	80	90	1,319,497	580,683	1,900,180	$27,400,430	$1,946,000	$7,337,000	$36,685,430	$33.38

							Costs: Dredging Cost	Costs: Design and Constr. Mgt Cost (1%)	Costs: Contingency Cost (25%)	Costs: Total Cost Parent	
		Parent to MBDS =			1,664,000		$13,067,840	$131,000	$3,300,000	$16,498,840	
										$53,184,270	
										$7,081,500	Rock
										$60,265,770	

ASSUMPTIONS

Footprint (area) provided by Normandeau (possibly from Melsburger report).
Existing depth obtained from navigation chart soundings.
Proposed sediment thickness is the difference between existing and excavated depths minus the 3 foot cap.
Side slopes of 1 vertical to 3 horizontal were assumed.
Volumes shown are dredged volumes (expansion of dredged material has not been applied).
Dredging costs account for dredging CAD and Boston Harbor sediments. (Melsburg mat. = $6.66, parent = $7.76, silt = $9.16).
No value was assigned to material excavated from disposal sites.
Design effort involves minimal site hydrographic surveys ($20,000)and benthic and fish studies ($10,000).
Contingency is 25%.

TABLE 3-19 (CONTINUED). COST ESTIMATES FOR AQUATIC BORROW PIT OPTION FOR BHNIP SILT DISPOSAL

CAD (Spectacle)

Footprint (Sq Ft)	Perimeter (FT)	Existing Depth Below MLW (FT)	Excavate to Depth Below MLW (FT)	Volume: Silt Volume (CY)	Volume: 3' Cap Volume (CY)	Volume: Total Volume (CY)	Costs: Dredging Cost	Silt Curtain Cost ($30/SY)	Design and Const. Mgt Cost (7%)	Contingency Cost (25%)	Total Cost	Unit Cost for Silt ($/CY)
1,874,554	4,980	8.3	31.3	1,316,768	218,905	1,535,671	$17,244,430	$96,000	$1,237,000	$4,644,000	$23,221,430	$21.13

		Dredging Cost	Design and Const. Mgt Cost (1%)	Contingency Cost (25%)	Total Cost
ASSUMPTIONS	Parent to MBDS = 1,684,000	$13,067,840	$131,000	$3,267,000	$16,465,840

The CAD is to be located further offshore than CA/T plan to avoid unsuitable material.
Footprint (area) planimetered from navigation chart for two different sized areas.
Existing depth calculated from navigation chart soundings within area.
Proposed sediment thickness is the difference between existing and excavated depths minus the 3 foot cap.
Side slopes of 1 vertical to 3 horizontal were assumed.
Volume shown are dredged volumes (expansion of dredged material has not been applied).
Dredging costs account for dredging CAD and Boston Harbor sediments. (CAD mat. = $4.71, silt = $8.42, parent = $7.76)
Design effort involves minimal site hydrographic surveys ($20,000) and benthic and fish studies ($10,000).
Contingency is 25%.
Silt curtain was assumed to consist of two square enclosures 200' on a side and 16' deep.
No cost was assumed for deployment of silt curtain.

	$38,687,270
	$7,081,500 Rock
	$46,768,770

TABLE 3-20. COSTS FOR ALTERNATIVE TREATMENT TECHNOLOGIES FOR BHNIP DREDGED MATERIAL

TECHNOLOGY TYPE	COST PER TON	COST PER CUBIC YD
Thermal	$75 to $120	$113 to $180
Solvent Extraction, Soil Washing and Other Chemical Treatments	$80	$120
Biotreatment	$135	$200
Solidification/Stabilization	$90	$135
Physical, Mechanical & Landfill Disposal	$55	$80

TABLE 3-21. COST ESTIMATES FOR USING EXISTING AQUATIC DISPOSAL SITES FOR BHNIP SILT DISPOSAL

Boston Lightship

	Footprint (SF)	Silt Volume (CY)	3' Cap Volume (CY)	Remaining Parent Volume (CY)	Dredging Cost	Design and Constr. Mgt Cost (7%)	Contingency Cost (25%)	Total Cost	Unit Cost for Silt ($/CY)
Note 1 =>	8,454,800	1,107,500	1,055,500	628,100	$23,352,370	$1,655,000	$5,838,000	$30,845,000	$15 87

MBDS

	Footprint (SF)	Silt Volume (CY)	3' Cap Volume (CY)	Remaining Parent Volume (CY)	Dredging Cost (per CY)	Design and Constr. Mgt Cost (1%)	Contingency Cost (25%)	Total Cost	Unit Cost for Silt ($/CY)
Note 1 =>	8,454,800	1,107,500	1,055,500	628,100	$23,774,261	$258,000	$6,008,000	$30,040,000	$13.05
Note 2 =>	8,454,800	1,099,100	1,055,500	628,100	$23,693,033	$257,000	$5,988,000	$29,938,000	$27.24
Note 3 =>	8,454,800	1,099,100	1,055,500	628,100	$18,818,977	$208,000	$4,757,000	$23,784,000	$21.64
Note 4 =>	8,454,800	1,099,100	1,055,500	628,100	$10,628,297	$126,000	$2,689,000	$13,443,000	$12.23

$7,081,500 Rock

$37,019,500

ASSUMPTIONS

Dredge costs - silt = $9.67,parent and cap = $7.76.
Unit cost for silt disposal = (dredge cost for silt + dredge cost for cap) divided by silt volume
Cap volume calculated for 3' cap over footprint of 9,500,000 SF.
Volumes shown are dredged volumes (expansion of dredged material has not been applied).
Design effort involves minimal site hydregraphic surveys ($20,000).

Note: 1) Unit cost doesn't consider remaining parent material or design/contingencies costs.
2) Unit costs include all parent material, design and contingencies costs. (expanded vol)
3) Unit cost doesn't consider remaining parent material but does consider design/contingencies costs. (expanded vol)
4) Unit cost includes only silt, design and contingencies it does not include cap.

TABLE 3-22.

COMPANIES SENT QUESTIONNAIRES FOR INFORMATION TREATMENT TECHNOLOGY FOR THE BOSTON HARBOR NAVIGATION IMPROVEMENT PROJECT

COMPANY	RESPONSE
Retech, Inc., Ukiah, CA	None
IT Corporation, Knoxville, TN	None
ConTeck Environmental Services	Yes
Canonie Environmental Services Corp. (SoilRech ATP Systems, Inc.)	Yes
ECOVA Corporation	None
Carlo Environmental Technologies, Inc.	Yes
Separation and Recovery Systems, Inc.	Yes
Maxymillian Technologies (formerly Clean Berkshires, Inc.)	Yes
Hrubetz Environmental Services, Inc.	Yes
Seaview Thermal Systems	None
Remediation Technologies, Inc.	None
SRE, Inc.	None
ART International, Inc.	Yes
CF Systems Corp.	None
Dehydro-Tech Corp.	Yes
Bergmann USA	None
Cleantech of Arkansas, Inc.	None

TABLE 3-22 (CONTINUED)

COMPANIES SENT QUESTIONNAIRES FOR INFORMATION TREATMENT TECHNOLOGY FOR THE BOSTON HARBOR NAVIGATION IMPROVEMENT PROJECT

COMPANY	RESPONSE
OHM Corporation	Yes
Grace Dearborn, Inc.	None
MEET	None
Marine Remediation Systems, Inc.	None
Concurrent Technologies Corp.	None
LADS Systems, Inc.	Yes
Applied Environmental Recycling Systems	None
ReSHAPE Corporation	None
Laidlaw Waste Systems, Inc.	Yes
Bardon Trimount Inc.	None
WEB Engineering Associates, Inc.	None
IWT Corporation	None
GeoCon	None
Modell Environmental Corporation	None
Commercial Paving Co., Inc. (Commercial Recycling Systems)	Yes
Charles Group Inc.	None
Waterways Experiment Station	None

TABLE 3-22 (CONTINUED)

COMPANIES SENT QUESTIONNAIRES FOR INFORMATION TREATMENT TECHNOLOGY FOR THE BOSTON HARBOR NAVIGATION IMPROVEMENT PROJECT

COMPANY	RESPONSE
Zenon Environmental Inc.	None
BioSafe, Inc.	Yes
Soil Technology	Yes
Resources Conservation Company	None

TABLE 3-23. TECHNOLOGY SURVEY QUESTIONNAIRE RESPONSES

The following abbreviations and notations apply to the following Table 3-23.

b	bench scale
c	commercial scale
d	day
D	demonstration
Dm	demobilization
dw	dewatering
el	electricity
hrs	hours
l	laboratory scale
M	mobilization
m	month
min	minutes
Ms	moisture
mt	metals
N	No
NA	not available/applicable
ng	natural gas
o	organics
pp	proprietary
pt	pilot scale
sc	screen
sft	square feet
t	theoretical
Y	Yes

TABLE 3-23. TECHNOLOGY SURVEY QUESTIONNAIRE RESPONSES

COMPANY	ART International	BioSafe	Cario Environmental Technology	Commercial Recycling Systems
TECHNOLOGY TYPE	Solvent Extraction	Thermal Destruction	Thermal Desorption	Solidification Stabilization
EFFECTIVENESS				
Demonstrated Through-Put cy/d	2	1000	525	1000
Maximum Through-Put cy/d	3	8000	600	NA
Meet Target Levels	O-Y M-N	O-Y M-Y	O-Y M-N	O-Y M-Y
Waste By-Products	Yes	Yes	No	No
Applicable to Dredged Material	Yes-b&pt	Yes-b&pt	Yes	Yes-c
Efficiencies in Scale	NA	Yes	Yes	Yes
Minimum Contaminant Concentr	None	NA	None	None
Processing Time	None	NA	600 cy/d	Varies
IMPLEMENTABILITY				
Pre-Treatment Requirements	Yes-sc&dw	Yes-sc&dw	Yes-sc&dw	Yes-dw
Mob-Demob Requirements	M-2m,Dm-1m	M-2m,Dm-2m	M-2wk,Dm-NA	M-2d,Dm-NA
Space Requirements	15,000 sft	NA	70,000 sft	10,000 sft
Traffic Impacts	Truck	None	None	Truck
Logistics	15,000 sft	NA	Land	Land
Special Fabrication	None	None	None	None
Building Requirements	Yes	Yes	Yes	Yes
Availability of Technology	Pp,I,pt	C	C	Pp,I,c
Number of Handling Events	Two	Varies	Three	Seven
Environmental Impacts	Air	None	Air	Water
Permittability	Air, Water	Water	Air	Air, Water
Site Safety	Yes	No	No	No
Environmental Constraints	None	None	Tm, Ms	Tm
Marketability of Residuals	Yes	Yes	Yes	Yes
COST DATA				
Estimated Price Range	$55-$65/ton	$122/ton	$28-$40/ton	$55-$95/ton
Factors Affecting Price:				
Initial Contaminant Concentrati	2	1	8	8
Target Contaminant Concentra	1	9	5	9
Quantity of Waste	4	2	9	2
Characteristics of Residuals	5	4	10	10
Labor Rates	4	10	7	8
Moisture Content	2	6	4	1
Facility Preparation	3	7	9	5
Waste Handling	3	3	3	4
Characteristics of Material	4	5	2	3
Utility/Fuel Rates	5	8	1	7

TABLE 3-23 (Continued) TECHNOLOGY SURVEY QUESTIONNAIRE RESPONSES

COMPANY	ConTeck Environmental Services	Dehydro-Tech Corporation	Hrubetz Environmental Services, Inc.	LADS System, Inc
TECHNOLOGY TYPE	Thermal Desorption	Solvent Extraction	Thermal Desorption	Thermal Solid/ Stebilization
EFFECTIVENESS				
Demonstrated Through-Put cy/d	750	50 t/d	10	None
Maximum Through-Put cy/d	360 t/d	NA	NA	1000
Meet Target Levels	O-Y M-N	O-Y M-N	O-S M-N	O-NA, M-Y
Waste By-Products	No	Yes	Yes	Yes
Applicable to Dredged Material	Yes	Yes-t	Yes-t	Yes-l
Efficiencies in Scale	Yes	Yes	NA	Yes
Minimum Contaminant Concentr	None	None	NA	None
Processing Time	20 min	1-2 hrs	Varies	hrs
IMPLEMENTABILITY				
Pre-Treatment Requirements	Yes-sc&dw	Yes-sc	Yes-sc&dw	Yes-sc&dw
Mob-Demob Requirements	M-2wk,Dm-NA	M-2yr,Dm-NA	M-1wk,D-1wk	M-1-2yr,D-1wk
Space Requirements	39000 sft	NA	6,700 sft	NA
Traffic Impacts	Truck	Varies	Unknown	Truck
Logistics	w, rg, el	NA	Lend	Barge
Special Fabrication	Yes	None	Yes	None
Building Requirements	Yes	Yes	None	None
Availability of Technology	C	Pp,I,pt,c	C	Pp,pt
Number of Handling Events	Five	NA	Varies	Six
Environmental Impacts	Air, sec	None	Air	Air, Water
Permittability	Air, Water	Air, Water	NA	Air, Water
Site Safety	Yes	No	Air, Noise	Noise, Odors
Environmental Constraints	Tm, Ms	None	Ms	
Marketability of Residuals	Yes	No	No	No
COST DATA				
Estimated Price Range	$26-$65/ton	$50-$150/ton	$40-$100/ton	$90-$130/ton
Factors Affecting Price:				
Initial Contaminant Concentrati	6		9	
Target Contaminant Concentra	2		5	
Quantity of Waste	3	1	6	1
Characteristics of Residuals	8		10	
Labor Rates	6	3	7	
Moisture Content	1		1	
Facility Preparation	7	1	8	
Waste Handling	5	2	3	
Characteristics of Material	4	2	2	3
Utility/Fuel Rates	5	3	4	2

TABLE 3-23 (Continued) TECHNOLOGY SURVEY QUESTIONNAIRE RESPONSES

COMPANY	Leidlaw Waste Systems	Mexymillion Technologies	OHM Remediation Services Corporation	Separation and Recovery Systems	SoilTech ATP Systems, Inc.
TECHNOLOGY TYPE	Lined Landfill	Thermal Desf/ Incineration	Slurry-Phase Bio-Treatment	Thermal Desorption	Thermal Desorption
EFFECTIVENESS					
Demonstrated Through-Put cy/d	2500	200-1400	135	100	200
Maximum Through-Put cy/d	2500	200-1400	275	300	700
Meet Target Levels	NA	O-Y M-N	O-Y M-N	O-Y M-N	O-Y M-N
Waste By-Products	NA	Yes	Yes	Yes	No
Applicable to Dredged Material	Yes	Yes-d	Yes-b	Yes-t	Yes-o
Efficiencies in Scale	NA	Yes	Yes	Yes	No
Minimum Contaminant Concentr	NA	None	Yes	None	None
Processing Time	NA	10-30 min	5-15 day	NA	40 min
IMPLEMENTABILITY					
Pre-Treatment Requirements	None	Yes-sc&dw	Yes-sc&sw	Yes-sc&dw	Yes-sc&dw
Mob-Demob Requirements	None	M-1-2m,D-1m	NA	M-3m,D-1m	M-2m,D-2m
Space Requirements	NA	32,500 sft	NA	17,000 sft	62,500 sft
Traffic Impacts	NA	None	None	None	None
Logistics	NA	Land	None	10,000 sft	Storage
Special Fabrication	NA	None	None	None	Yes
Building Requirements	NA	Yes	Yes	Yes	Yes
Availability of Technology	C	C	C	C	C
Number of Handling Events	Once	Six	Four	Two	Four
Environmental Impacts	NA	Air, Water	None	None	None
Permittability	NA	Air, Water	Water	Air, Water	Air
Site Safety	No	No	No	No	Air, Odor
Environmental Constraints	NA	None	Tm	Tm, Ms	None
Marketability of Residuals	NA	NA	Yes	Yes	Yes
COST DATA					
Estimated Price Range	$50-$85/ton	$40-$200/ton	$130-$140/ton	$80-$225/ton	$50-$100/ton
Factors Affecting Price:					
Initial Contaminant Concentrati	2	8	1	6	6
Target Contaminant Concentra	2	9	1	5	10
Quantity of Waste		1	1	2	2
Characteristics of Residuals		10	2	8	7
Labor Rates		6	2	10	4
Moisture Content		4	2	1	1
Facility Preparation		5	2	7	8
Waste Handling		2	1	8	5
Characteristics of Material	1	3		4	3
Utility/Fuel Rates		7		11	9

TABLE 3-24. TECHNOLOGY RATING SUMMARY

COMPANY NAME	TREATMENT TECHNOLOGY	STATE OF DEVELOPMENT	APPLIED TO DREDGED MATERIAL	AVAILABILITY	RATING			COMPOSITE SCORE
					EFFECTIVENESS	IMPLEMENTABILITY	COSTS	
ART International, Inc.	Solvent Extraction	Pilot	No	Proprietary	M=0, O=4	2	3	9
Biosafe	Thermal Destruction	Demonstrated	No	Commercial	M=0, O=4	3	2	9
Carlo Environmental	Thermal Desorption	Demonstrated	Yes	Commercial	M=0, O=4	3	3	10
Commercial Recycling	S/S	Demonstrated	Yes	Commercial	M=3, O=3	4	3	13
ConTeck Environmental	Thermal Desorption	Demonstrated	No	Commercial	M=0, O=4	3	3	10
Dehydro-Tech Corp.	Solvent Extraction	Demonstrated	No	Proprietary	M=0, O=4	3	3	10
Hrubetz Environmental	Thermal Desorption	Demonstrated	No	Commercial	M=0, O=3	3	3	9
LADS System, Inc.	Thermal S/S	Pilot	Yes	Emerging	M=3, O=NA	2	2	7
Laidlaw Waste Systems	Lined Landfill	Demonstrated	Yes	Commercial	M=3, O=3	4	3	13
Maxymillian Technologies	Thermal Destruction	Demonstrated	Yes	Commercial	M=0, O=3	4	2	9
OHM Remediation Services	Bio-treatment	Demonstrated	No	Commercial	M=0, O=3	3	3	9
Separation and Recovery	Thermal Desorption	Demonstrated	No	Commercial	M=0, O=3	3	2	8
SoilTech ATP Systems	Thermal Desorption	Demonstrated	Yes	Commercial	M=0, O=4	4	3	11

TABLE 3-25. **PORTS MEETING MINIMUM DEPTH REQUIREMENTS FOR TRANSFER OF BHNP MATERIAL TO UNLINED MUNICIPAL LANDFILLS**

PORT[1]	DEPTH RELATIVE TO MLW	PROXIMAL UNLINED MUNICIPAL LANDFILLS[2]
Gloucester Inner Harbor	varies, > 15± ft.	Gloucester, Rockport, Rowley, Topsfield, Haverhill
Salem Harbor	30± ft.	Topsfield, Middleton, Lowell, Reading, Woburn, Andover
Beverly Harbor	varies, > 19± ft.	Topsfield, Middleton, Lowell, Reading, Woburn, Andover
Lynn Harbor	13 ft. in 1970 from Feb. '78 NOAA chart, No. 13275	Newton, Reading, Lowell, Reading

PORT	DEPTH RELATIVE TO MLW	MUNICIPALITIES
Chelsea Creek	varies, but sufficient	Natick, Needham, Newton, Milton, Millis
East Boston	varies, but sufficient	Natick, Needham, Newton, Milton, Millis
South Boston	varies, but sufficient	Natick, Needham, Newton, Milton, Millis
Weymouth, Fore River	varies, > 22 ft.	Milton, Needham, Cohasset, Newton, Norwood, Sharon, Holbrook, Rockland, Weymouth, Scituate
Plymouth Cordage	11 ft. (1977) at MLW	Middleboro, Duxbury, Marshfield, Bourne, Lakeville, Plymouth, Kingston, Rockland, Scituate
New Bedford/Fairhaven	varies, > 15 ft.	New Bedford, Fairhaven, Dartmouth, Westport, Freetown, Mattapoisett, Lakeville, Middleboro, Raynham, Taunton
Mount Hope Bay	varies, > 15 ft.	Freetown, Lakeville, Attleboro, Taunton, Raynham, New Bedford, Fairhaven, Middleboro

[1] From: Designated Port Areas as defined in the Wetlands Protection Act Regulations (310 CMR 10.26).

[2] From: Central Artery/Third Harbor Tunnel Clay Distribution List, July 5, 1994.

TABLE 3-26. SCREENING MATRIX FOR DETERMINING THE LEAST ENVIRONMENTALLY DAMAGING PRACTICABLE ALTERNATIVE FOR DISPOSAL OF SILT FROM THE BHNIP.

TYPE	SITE	PERMANENT HABITAT LOSS OR ALTERATION	WATER QUALITY EXCEEDENCES BEYOND DISPOSAL SITE	SOCIOECONOMIC EFFECTS	REASONABLE CAPACITY	BENEFICIAL USE[b]	COST ($/cy)	LEAST ENVIRONMENTALLY DAMAGING ALTERNATIVES
LANDFILL	E. Bridgewater	no	no	displacement of other users	no	minor	$62	*
	Fitchburg/ Westminster	no	no	displacement of other users	no	minor	$108	*
	Plainville/ Laidlaw	no	no	displacement of other users	no	minor	$94	*
LAND-BASED-Inland	Woburn	no	no	traffic	no	cap landfill	$69	
	Wrentham	yes	no	traffic	yes	no	$62	
Coastal	Everett	yes	no	minor	no	no	$76	
	Squantum Point	yes	no	neigborhood, traffic	yes	no	$45-$50	
AQUATIC Shoreline (Partial Fill)	Amstar	altered	mitigated	displacement of MWRA pier	no	contain contaminants	$37	*
	Cabot Paint	altered	mitigated	minor	no	contain contaminants	$278	*
	Little Mystic Channel	altered	mitigated	neighborhood	yes	contain contaminants	$30	*

TYPE	SITE	PERMANENT HABITAT LOSS OR ALTERATION	WATER QUALITY EXCEEDENCES BEYOND DISPOSAL SITE	SOCIOECONOMIC EFFECTS	REASONABLE CAPACITY	BENEFICIAL USE[b]	COST ($/cy)	LEAST ENVIRONMENTALLY DAMAGING ALTERNATIVES
	Mystic Piers	altered	mitigated	minor	no	contain contaminants	$35	*
	Reserved Channel	altered	mitigated	neighborhood, traffic	yes	resource enhancement; contain contaminants	$85	*
	Revere Sugar	altered	mitigated	minor	no	contain contaminants	$35	*
Subaqueous	Subaqueous B	altered	yes	minor	yes	no	$20	
	Subaqueous E	altered	yes	minor	yes	no	$19	
In-Channel	Chelsea Creek	no	mitigated	minor	yes	no	$37	*
	Inner Confluence	no	mitigated	minor	no	no	$37	*
	Mystic River	no	mitigated	minor	yes	no	$37	*
Borrow pit	Meisburger 2	no	no	displacement of fisheries	yes	minable resource	$31	
	Meisburger 7	no	no	displacement of fisheries	yes	minable resource	$33	
	Spectacle Island CAD	no	mitigated	minor	yes	minor	$21	*
Existing	MBDS	no	no	minor	yes	no	$16	*

TYPE	SITE	PERMANENT HABITAT LOSS OR ALTERATION	WATER QUALITY EXCEEDENCES BEYOND DISPOSAL SITE	SOCIOECONOMIC EFFECTS	REASONABLE CAPACITY	BENEFICIAL USE[b]	COST ($/cy)	LEAST ENVIRONMENTALLY DAMAGING ALTERNATIVES
Disposal Site								
	Boston Light Ship	no	no	displacement of fisheries	yes	no	$27	*
TREATMENT	Various	no	no	minor	yes	potentially	$55-$200	

≥200,000 cy
through site preparation or use of silt, parent material not included since it has universal benefit
cost could be reduced by beneficial use of mined sediments

Chapter Four: Selection Of Preferred Disposal Location

This Chapter provides a detailed environmental analysis of potential disposal sites to determine the least environmentally damaging and practicable alternative for the disposal of silt from the BHNIP.

Under NEPA (40 CFR 1505.2) and MEPA (MGL c.30, s.61-62h and 301 CMR 11.00), the BHNIP must demonstrate that the proposed project avoids or minimizes any adverse impacts to environmental quality. This analysis must consider all applicable local, State and Federal regulations, including Section 404 of the Clean Water Act and the 404(b)(1) Guidelines (40 CFR 230.20-.54), the Massachusetts Wetlands Protection Act (MGL c.131, s.40) and its implementing regulations (310 CMR 10.00), the Massachusetts Waterways Act and its implementing regulations (310 CMR 9.00), and consistency with the Massachusetts Coastal Zone Management Program regulatory and non-regulatory policies, and federal consistency (MGL c.6A, s.2-7; c.21a; c.706; and c.1230) and their implementing regulations (301 CMR 20.00 and 21.00).

The selection process involves comparison of the long-term and short-term impacts that would arise through implementation of each alternative. The "short-list" of land-based and aquatic-based sites, selected as a result of the site screening process described in Chapter 3 (see Table 3-1), is evaluated based on direct and indirect impacts within each alternative. The evaluation of environmental impacts at potential disposal sites includes information developed as a result of comments on the DEIR/S. The information collected since the DEIR/S caused us to reduce the available footprint of the Wrentham site. For example, to avoid impacts to Zone II aquifer protection area. Investigation at the aquatic disposal sites in the fall of 1994 confirmed our understanding of the biological conditions at the aquatic sites as evaluated in the DEIR/S.

In performing the LEDPA, identification of the least environmentally damaging alternative(s) is performed separately from the practicability analysis. These two issues have been separated in response to several comments received during review of the DEIR/S. Environmental impacts now receive more emphasis than practicability, and thus is more in keeping with the intent of the above-stated regulations. Separating the analyses also permits identification of sites that may be more suitable for other disposal projects or for disposal of future maintenance material from the BHNIP.

For example, while a number of the sites discussed in this section would have insufficient capacity to be used as the sole

repository of the silt from the BHNIP, they could be of interest for a combination of alternatives, if practicable, or a smaller project in the future. This assessment of environmental effects addresses these sites from the dual perspectives of suitability for the BHNIP and for future maintenance or an unidentified future project. Site capacity is relevant in comparing environmental impacts because the use of several sites requires construction disturbances at each and therefore, have greater cumulative environmental impacts.

The parallel process for identifying the most practicable alternative(s) is based on an assessment of technical requirements and constraints, and a comparison of cost estimates for each site. Selection of the LEDPA results from the weighting of the least environmentally damaging alternatives with the practicability analysis results.

The following section identifies the least environmentally damaging alternative among the short-listed, land-based sites.

4.1 LAND-BASED SITES

Land-based sites are being considered in the context of providing an alternative for placement of approximately 200,000 cy, in the event that there are volume, suitability, permitting or practicability constraints from other alternatives that cannot be resolved. Potential land-based sites include the short-list of coastal sites and inland sites identified on Table 3-1. Consideration of the land-based sites involves two aspects: generic issues which are applicable to all land-based sites; and site-specific issues which are unique to individual sites. The following land-based sites are considered in this discussion:

Lined Landfills

- BFI-East Bridgewater Landfill
- Plainville Sanitary Landfill
- Fitchburg-Westminster Sanitary Landfill

Coastal Sites

- Squantum Point
- Everett

Inland Sites

- Woburn
- Wrentham

Full descriptions of each site are provided in Attachment 1 to this Volume.

4.1.1 Generic Issues

Use of any of the land-based sites for silt disposal will require that the silt be transported by barge to a waterfront dewatering facility, off-loaded onto the facility, dewatered, and loaded onto trucks, rail cars, or barges for transportation to the land-based disposal site for final disposal. With each additional handling and transportation step, the potential for environmental impacts increases. This section will address several of the major issues unique to land-based disposal, specifically dewatering and hauling. Additionally, proposed use of any inland site as a disposal facility (monofill) would trigger a rigorous

environmental site review under the Massachusetts DEP Solid Waste Siting Suitability regulations.

4.1.1.1 Dewatering

Land-based transport and handling logistics require that the silt material be dewatered prior to hauling to a land-based disposal area. The present water content of the in-situ silts ranges from 33%-74%, with an average water content of 51%. For economical and safe handling, transportation, and disposal, the water content will need to be reduced so that no free water is available.

Several dewatering options are available for dredged materials. These include air drying, mechanical drying, chemical stabilization and mixing with dry material. However, the sheer volume of silt material to be dredged in the BHNIP eliminates most options as environmentally risky, too costly or slow (see Appendix I for a description and assessment of dewatering technologies). Of the available options, the least problematic and most economical methods are mechanical dewatering with belt presses, and air drying. A combination of the two methods may be most feasible.

Belt filter presses have been effectively used on numerous projects of similar magnitude, including dewatering of municipal sludges, industrial processing sludges and harbor silts. Belt filter presses have the distinct advantages of being mobile, requiring relatively little space, being unaffected by precipitation and temperature, and generating few odor problems. A potential limitation to belt filter presses on the BHNIP project is that the silt has a high clay content that may be difficult and slow to process with this method.

A single 2-meter wide belt filter press is truck-mounted and can process approximately 350 cy of silt per day, assuming a 24-hour operation. Six presses would be required to process the silt from a 2,000 cy scow. At this daily rate, dewatering 200,000 cy would be accomplished in approximately 4 months. The silt might need to be mixed with water and a polymer to achieve the desired consistency for spreading on the presses. The leachate from the presses could potentially be recycled into the mixing tank for future processing, thereby reducing the need for water treatment. The recycled leachate would be treated on-site using portable flow-through filters to remove particulates and contaminants prior to discharge into the Harbor, in order to meet water quality criteria.

To air dry the silts, a series of diked and sealed asphalt containment cells would need to be constructed at one or several sites. Air drying estimates indicate that approximately 5 acres are required to handle 15,000 cy of silt, assuming a maximum depth of 2 feet (see Appendix I). An average of 14 days is anticipated, with daily working of the silts, to reduce the water content so that no free water remains. Because this method relies on suitable weather, its use would be limited to the standard construction season (April-November), and would not be efficient during rainy or high humidity periods.

Most of the water would be removed by evaporation, although some discharge would occur to remove surface water picked up during the dredging process and precipitation from storm events. Assuming that a maximum of 56,000 cy of silt can be dredged per week, approximately 20 acres would be necessary to air dry one week's worth of silt. Ideally, four 20-acre sites consisting of four 5-acre cells each, for a total of 80 acres would be needed. This arrangement would provide sufficient space to allow for one site for off-loading silts, a second site in which silts are drying, a third site for removing the dried silt, and a fourth site for emergency storage during wet weather or unexpected delays in transporting off-site. A settling basin would be needed for every 10 acres of cells to collect and treat excess water prior to discharge back into the Harbor. This dewatering arrangement would be necessary to keep pace with dredging and allow 200,000 cy of silt to be dredged, dewatered and hauled to an upland site in 6 to 8 weeks.

Sufficiently large areas of open space on Boston Harbor are very limited. Reduction of the space available for dewatering would result in lengthening the time needed to complete the upland disposal dredging. For example, dedicating only one dredge to upland silt disposal would cut the acreage needed in half, to 40 acres, but would increase the operational time of the dewatering facility to approximately 12-14 weeks for 200,000 cy. The environmental and practicability impacts relating to each option would need to be weighed in order to determine if a balance between area and schedule could be achieved.

For both dewatering methods, loaded barges would need to be brought by tug to a berthing area near the facility for off-loading. It is important that the dewatering area(s) have the following features in order to allow efficient material offloading, dewatering and offsite transport of dewatered material:

- be located in direct proximity to the Harbor
- have adequate water depth and berthing facilities for loaded barges
- have adequate land area (minimum of 2 acres for belt filter presses and 5 acres for air drying) for barge offloading, construction of a dewatering facility and operation of land based equipment

Odor may be a major issue for dewatering via air drying. Standard odor controls such as daily cover and chemical agents will be unsuitable because they function by interfering with air exchange and evaporation and would, therefore, impede the drying process. Other potential impacts from air drying include water quality impacts from stormwater runoff and removal of the surface water collected during the dredging process, and noise from the equipment operation.

Several representative waterfront areas were identified for potential dewatering sites. These sites are located near the areas requiring dredging.

The approximate capacities of several possible dewatering areas are as follows:

Conley:
25 acres (overall area)
75,000 cubic yards (air drying containment capacity)

Revere Sugar:
13 acres (overall area)
39,000 cubic yards (air drying containment capacity)

Mystic Piers:*
3-8 acres (overall area)
15-24,000 cubic yards (air drying containment capacity)

North Jetty:
15 acres (overall area)
45,000 cubic yards (air drying containment capacity)

*Range includes potential of utilizing adjacent space at Piers 48, 49 and 50.

These sites are representative. Their actual availability depends on lease agreements and other competing uses occupying the sites when they would be needed for dewatering.

4.1.1.2 Hauling

Transport of silt material to the land-based sites from the dewatering facility will require loading the dewatered silts from the containment cell into barges for hauling to Everett and possibly Squantum Point (there is some potential for dewatering directly at Squantum Point; however, barge access will still be required), or into trucks for all other proposed land-based sites. Rail is a possible option, although no active tracks lead to any inland site so that off-loading onto trucks would ultimately be required.

For barges to access either Squantum Point or Everett, dredging would be needed to create a berth for off-loading. An estimated 2,300 cy of shallow subtidal dredging would be necessary at Everett to increase the existing 5-foot depth to the needed depth of 10 feet (see Attachment 1). At Squantum Point, approximately 13,000 cy of subtidal and 6,500 cy of intertidal dredging would be necessary to gain shore access (Attachment 1). Some of the intertidal habitat impacted at Squantum Point may include salt marsh. These dredged sediments would need to be tested to determine what proportion, if any, required special handling.

Trucking considerations include traffic, noise, and roadwear in Boston and on the secondary roads leading from major highways to the Wrentham-495 and the Woburn sites, and landfills. Assuming a 20 cy capacity for the trucks, approximately 10,000 truckloads would be required to transport the material, which translates to a maximum of 238 truck trips per day at the highest dewatering rate.

4.1.1.3 Solid Waste Siting Suitability

Disposal at the inland coastal sites would require that the site meet DEP's solid waste siting criteria (310 CMR 16.40). This permit requirement clearly does not

apply to the listed lined landfills. At all upland sites, site suitability for construction of a secure landfill would need to be determined. The siting and permitting of a new solid waste facility in the Commonwealth of Massachusetts is a lengthy process. Initially an application for the suitability of the site must be submitted to the Massachusetts Department of Environmental Protection. The application must include: 1) documentation that the selected site meets the suitability criteria; 2) the engineering design report; 3) the landfill operations and management plans; and 4) certification that the applicant has complied with the Massachusetts Environmental Policy Act. The application is then reviewed by the DEP and public hearings are held to obtain comments from the affected community. The entire process, including site investigations, landfill design and permitting, may require three to five years. The actual time required for the permitting of a facility may vary from this estimate, depending on the complexity of the site conditions and environmental constraints, time required by the DEP to review the documentation and the level of public concern.

Given the difficulty of siting and permitting a disposal site, the land-based options may be more suitable for future maintenance material.

4.1.2 Direct Impacts

This section describes the direct environmental impacts associated with the land-based sites. The impacts include permanent and temporary loss of federal or state resources and the permanent alteration of resources from the existing conditions to altered conditions after construction. The impacts discussed in this section are attributable to the upland inland and coastal sites only; no direct or indirect impacts would occur with use of the lined landfills because the facilities are currently constructed and operating.

4.1.2.1 Permanent Loss

Both inland sites, Woburn and Wrentham, have jurisdictional wetland habitat within their respective footprints. Construction of a disposal facility would permanently fill these resources and eliminate their associated functions (Table 4-1). At Woburn approximately 1 acre of forested wetland would be affected, and avoidance would be very difficult due to the physical configuration of the site. At Wrentham, most of the major wetland areas have been avoided in calculating the usable site acreage. New information provided by the DEP, since the DEIR/S, indicates a 15-acre area containing numerous isolated wooded wetlands. Avoidance of these wetlands reduces the available capacity of the site from the 785,000 cy stated in the DEIR/S to approximately 525,000 cy. No permanent loss of jurisdictional wetlands would occur at Everett or Squantum Point.

At all of the inland and coastal sites, construction of the disposal facility would result in the permanent loss of vegetation and wildlife habitat within the footprint of the facility. Current conditions at three of the sites, Squantum Point, Everett, and Woburn, are moderately to highly disturbed with predominantly bare or

artificial substrates and early successional vegetation. At the fourth site, Wrentham, the habitat is predominantly undisturbed forest and shrubland, although sand and gravel operations have left the southern tip of the site highly disturbed. Wildlife habitat values are correspondingly low at Squantum Point, Everett and Woburn, although at Squantum Point, wildlife habitat value is relatively higher in spite of the site's disturbed condition because it provides open land on an urbanized harbor. At Wrentham, wildlife habitat values are considerably higher due to the site's large size and relatively low degree of disturbance.

4.1.2.2 Temporary Loss

Temporary loss is presumed to be a less serious impact than permanent loss because the functions attributed to the lost resource would be regained. In the case of wetland habitat, the Federal "no net loss" policy would be maintained. Temporary losses at the land-based sites would include channel dredging in the shallow subtidal areas of Squantum Point and Everett to allow barge access (Table 4-1). The maximum depth of dredging is anticipated not to exceed 6-8 feet, therefore the benthic community that re-established after dredging should be very similar in composition and structure to the original community. Also, at these two coastal sites, the use of the surrounding mudflats and beaches by shorebirds and waterfowl could be disrupted by on-site activities; however use should resume upon closure of the facility. The common terns observed in courtship on the abandoned pier at Everett will also likely avoid the site during disposal activities, but could return upon closure.

At the inland land-based sites, temporary impacts due to odor and noise may occur along trucking routes that pass sensitive receptors such as residential areas and schools. These impacts would likely be more obvious in the suburban roads of Woburn because at Wrentham, Green Road and Route 1A, are already used by quarry and asphalt trucks. Temporary odor impacts would cease upon completion of the silt disposal. Noise impacts would continue through capping and closure of the facility.

4.1.2.3 Permanent Alteration

At Squantum Point, permanent habitat alteration would occur with channel dredging for barge access in the 0.3-acre intertidal zone where mudflat, and possibly salt marsh, would be converted to subtidal land. This would result in changing the functions and values of the area from intertidal (primarily migratory bird resting and feeding habitat, intertidal productivity, water quality treatment and shoreline stability) to those of subtidal areas (primarily shellfish and finfish feeding and breeding habitats). This alteration could be mitigated at closure by restoring intertidal conditions to the affected areas.

4.1.3 Indirect Impacts

The primary indirect impacts would potentially occur at Wrentham, and include risk to a Zone II aquifer, forest

fragmentation, and loss of tax base if a proposed industrial subdivision were precluded. The Zone II aquifer lies under the northernmost portion of the site. Avoiding the aquifer, in combination with avoidance of the wetlands (see Permanent Losses section) further reduces the capacity of the Wrentham site to 451,000 cy. Forest fragmentation would result because most of the portion of the site proposed for the containment facility (excluding the southernmost portion which is disturbed) is currently part of a large block of undeveloped shrub/forested land. Upon site closure, the facility would be capped and could be managed as natural habitat, but because penetrating roots are usually discouraged on permanent caps, it is unlikely that forested habitat would be allowed to develop. Loss of potential tax base to the Town of Wrentham could result if an industrial subdivision currently proposed at the northern end of the parcel were precluded by development of the disposal facility. However, because this portion of the parcel overlies the Zone II aquifer, and would likely be avoided by BHNIP, the two projects could potentially be developed concurrently.

At Squantum Point, indirect impacts would include a potential conflict with a proposed MDC park at the site. Park development plans could be feasible after closure and capping of the disposal facility.

Other indirect impacts that are common to all four land-based sites are noise and odor impacts to sensitive receptors, primarily residences, surrounding the sites. Noise could be partially mitigated by limiting operations to hours of the day that minimize the impact. Potential odor controls include use of chemical agents to mask or seal odors, or the application of a daily cover material. The need for daily cover could substantially reduce the capacity of the facility for silt disposal.

4.1.4 Identification of the Least Environmentally Damaging Land-Based Alternatives

Impacts to the lined landfills and the four upland alternatives evaluated herein are summarized in Table 4-1. The three lined landfills are treated together and obviously have the fewest environmental impacts because the facilities have already been constructed and are equipped to control any potential operational impacts such as odor or noise. Primary differences among the upland sites include impacts to freshwater wetlands (Woburn) and intertidal wetlands (Squantum Point), traffic and neighborhood issues, and impacts to non-wetland habitats. Based on these issues, the sites would be ranked (from least to greatest impact):

- Lined Landfills
- Everett
- Wrentham
- Woburn
- Squantum Point

These sites are subjected to the practicability screening in Section 4.4.

4.2 AQUATIC SITES

The short-list of aquatic sites presented in Chapter 3 includes sites from several

categories. These sites are shown on Figure 4-1.

Shoreline
- Amstar
- Cabot Paint
- Little Mystic Channel
- Mystic Piers
- Reserved Channel
- Revere Sugar

Subaqueous Depressions
- Subaqueous B
- Subaqueous E

Borrow Pits
- Meisburger 2
- Meisburger 7
- Spectacle Island CAD

In-Channel Sites
- Chelsea Creek
- Inner Confluence
- Mystic River

Existing Disposal Sites
- Boston Lightship

The proposed disposal scenario would be unique to each type of site. Shoreline sites are aquatic areas contiguous to the Boston Harbor shoreline. The existing site boundaries are defined by man-made bulkheads and walls, with one side exposed to the Harbor. There are two fill alternatives proposed for the Amstar, Cabot Paint, Little Mystic Channel, Mystic Piers and Revere Sugar sites. The partial-fill alternative would result in a final elevation, including cap, of mean low water. The fast land alternative would result in filling to the elevation of the adjacent land. For both alternatives, a bulkhead would be constructed to isolate the site from the Harbor during disposal. The bulkhead would remain in place after disposal in the fast land alternative but be cut off at MLW after the cap was secured for the partial-fill alternative.

The alternative fill scenarios identified for the Reserved Channel involve partially filling different areas of the Channel upstream of the Summer Street bridge. Fill could be placed either in the entire area west of Summer Street or in the western end of that area. In either case, the western end would be filled to a final grade of +9 ft. MLW, a suitable elevation for establishing salt marsh vegetation. The eastern portion would be filled to a final elevation of -6 ft. MLW. Both areas would require bulkheading during disposal.

Use of the Outer Harbor Subaqueous sites B and E would rely on existing bathymetric conditions to keep disposed sediments in place. Sediments would be transported by bottom-dumping scow. After disposal of silt is complete, the area would be capped by depositing granular material over the sediments. The final elevation of each site would be no higher than the surrounding conditions.

Construction of any of the borrow pit sites, Meisburger 2, Meisburger 7 or Spectacle Island CAD, would require dredging existing sediments to create a pit in which to bury the silts from the BHNIP. In each case, a portion of the surface material present at the site would be retained to be placed over the BHNIP silts to isolate them from the water column and restore the substrate to preexisting

conditions. Sediments dredged from the Meisburger sites would likely be suitable for beneficial uses such as beach nourishment or construction aggregate.

In-channel disposal would occur within portions of the footprint of the channels to be dredged under the BHNIP. These areas would be deepened by dredging additional parent material. Because of the character of the subsurface sediments, the additional deepening can be done in confined cells. Individual cells would be filled soon after construction and capped with granular material soon after being filled. The extra parent material that would be dredged would be disposed in the same manner as the parent material originating from the planned dredging project.

Disposal at Boston Lightship (BLS) would require no site preparation. Barges would dump silt at a designated location resulting in a mound. The mound would be capped at the conclusion of the disposal activities.

4.2.1 Direct Impacts

Direct impacts could include the permanent or temporary loss, or permanent alteration, of aquatic habitat in the footprint of the disposal operation. The 404 (b)(1) guidelines direct the project proponent avoid or minimize the loss of aquatic habitat. The Corps and EPA have also established a Memorandum of Agreement stipulating a goal of no net loss of wetland values and functions.

4.2.1.1 Permanent Loss [404 (b)(1) issues]

Of the aquatic disposal alternatives evaluated for the BHNIP, any site where disposal of dredged material would raise the elevation of the site above the high water elevation would result in a permanent loss of aquatic habitat and the associated functions. This has been proposed only for one scenario involving the shoreline sites, i.e. creation of fast land. Because each of these sites abuts a filled shoreline, disposal would eliminate both subtidal and intertidal habitat. The subtidal habitat at these sites is composed primarily of soft, fine-grained sediments, whereas the intertidal habitat consists primarily of vertical bulkheading, composed of wood, steel, concrete, or rock. Selection of one of the shoreline sites for fill to fast land could be contrary to the goal of avoidance of loss of aquatic habitat, particularly if other sites were available and practicable and would not result in permanent loss of aquatic habitat.

Disregarding the issue of site capacity and the ability to meet the disposal needs of the BHNIP, the aquatic sites differ with respect to the level of direct impacts. The first level of comparison is the permanency of the impacts. Filling the aquatic shoreline sites (Amstar, Cabot Paint, Little Mystic Channel, Mystic Piers, or Revere Sugar) to fast land would result in the permanent loss of aquatic habitat (Table 4-2.). Although these areas were found to have relatively low capacity for bottom habitat productivity, and their individual footprints are small, federal regulatory concerns focus on the fact that Boston Harbor has experienced thousands of acres

of fill over the last two centuries. If this design was selected for disposal of the BHNIP sediments, it would require the filling of all the identified aquatic shoreline sites for a total permanent loss of 30.5 acres of subtidal estuarine habitat. Additional disposal alternatives would also be necessary because those sites could not hold all the project's silts. Individual sites range in size from 2.7 (Mystic Piers) to 15 (Little Mystic Channel) acres (Table 4-2).

4.2.1.2 Temporary Loss

Temporary loss of habitat is presumed to be a less serious impact than permanent loss because it minimizes the impact to aquatic habitat function. Habitat function in the footprint of disposal activities could be temporarily disrupted or lost under several scenarios. This concept assumes that it is possible to restore the affected substrate to (or near) its original character, so that biological activities could be re-established after disposal. This approach is proposed for the borrow pit sites, where material removed to create the pit would be stored adjacent to the pit, until construction of the final cap or closure of the site. This method ensures that both the physical and chemical composition of the surface sediments are restored. Construction of a borrow pit could also cause a temporary impact on an area adjacent to the pit because the cap material would likely be stored on the sea floor rather than on a barge. In the case of the offshore sites, dredging of the pits would be most easily accomplished with a hopper dredge, sidecasting material intended for use as a cap onto the adjacent substrate. Therefore, the adjacent substrate habitat would also be temporarily impacted. Storage of the cap sediments underwater, in the same conditions as the disposal site, could be beneficial to future recruitment of organisms to the cap.

4.2.1.3 Permanent Alteration

In some cases, although there would be no permanent loss of aquatic habitat, use of a site for disposal of dredged materials could alter the substrate in either of two ways, through a change in depth or a change in substrate character. At sites where little or no site preparation (e.g., the subaqueous sites in the Outer Harbor, and the shoreline sites under the partial fill scenario) would be required, disposal would reduce the site depth. The distribution of benthic organisms is not related strictly to depth, but more closely to physical features such as intertidal exposure, substrate texture (grain size) and current or wave regime. However, motile organisms associated with the substrate (e.g., winter flounder) seek out different depth strata over the course of their life cycles or in response to seasonal changes in environmental conditions. For instance, during periods of warm water temperatures, estuarine fish move into deeper areas to find cooler temperatures. This behavior is more prevalent in adult, rather than juvenile, fish.

Change in the physical or chemical character of the substrate is the other alteration that could occur. Sediment grain size distribution can have a significant effect on the distribution of benthic species

(Rhoads & Germano 1982), so a radical deviation from the conditions present at a disposal site could affect recruitment of benthos following capping. Presence of organics or contaminants in sediments could restrict the character of the benthic community to stress-tolerant, opportunistic species. The purpose of the cap at any of the potential aquatic disposal sites, however, would be to isolate these contaminated sediments from the surrounding environment. Any capping material used would need to meet all regulatory standards for unconfined, open water disposal and would, in fact, be of the same or better chemical quality than the present sediments at any disposal site. Therefore, the chemical quality of the sediment at the disposal site would not be compromised when capped.

Sites where capping could alter the physical character of the sediments include the in-channel sites, the Outer Harbor subaqueous sites and the partial-fill shoreline sites. The resulting chemical quality of the cap could be an improvement over existing site conditions at any of the in-harbor sites (e.g., in-channel or shoreline sites), although physical character could be different. Capping the dredged material with substrate similar to the existing substrate (if available) would increase the chance of returning populations to pre-dredge conditions. However, there is good reason to modify the existing substrate if the proposed substrate meets or exceeds the habitat productivity and diversity potential of the areas as they exist at present.

Direct impacts at all the other sites, as well as the partial fill scenario for the shoreline sites, would be temporary (Table 4-2). The sites can be compared on several criteria:

- the size of the impact area;
- physical changes to the site that could affect its functional value;
- the likelihood and rate that the benthic community, as an indicator of the functional value of the habitat, would return to pre-project conditions (a measure of the longevity of the temporary impacts)

A. Size of Impact

The comparison of impact size is appropriate only when placed in the context of whether the site has the capacity to fill the project's disposal needs. Even if all shoreline sites were partially filled for the BHNIP, their combined capacity would fall short of the disposal capacity needed. The total footprint altered would be about 47 acres, comparable to the footprint of the Spectacle Island CAD, which was designed to provide disposal capacity for the full volume of silt to be generated from the BHNIP. The In-channel alternatives (the Inner Confluence in combination with the Mystic and Chelsea Rivers) would be sufficient for all the BHNIP silts. Their combined footprint would be about 116 acres, although at any given time, the disturbed working footprint would be less than about 15 acres (two to six cells). In-channel disposal would occur only in the footprint of the channel deepening. Therefore, the in-channel alternative is the

only one that will not increase the impact area of the project beyond that of the dredging. Subaqueous B (83 acres) and E (79 acres) would impact similar footprints, but, even combined, would not provide the capacity needed for all the BHNIP. Each of the offshore sites would have sufficient capacity for the BHNIP sediments. Estimated impact footprints at these sites would range from about 86 acres (Meisburger 2) to 121 acres (Meisburger 7) (Table 4-2).

Based on footprint of impact alone, the Spectacle Island CAD would appear to result in substantially lower total impact than any of the other sites, except in-channel disposal. However, the dredging and disposal sequence, as it relates to the portion of the site impacted at any one time, must be considered. Geological conditions at Spectacle Island make it unlikely that this site could be developed in small consecutive cells, whereas the Meisburger and in-channel sites could be. In addition, this assessment must be qualified by evaluating exactly what the impact entails. Specifically, these include whether there are permanent alterations in habitat conditions, and the likelihood that the subtidal community (as an indicator of habitat value) would return to pre-project or improved conditions.

B. Physical Changes

Many of the sites evaluated would require permanent alterations in depth. Under the partial fill scenario, five of the shoreline sites would require filling subtidal areas to intertidal elevations. The sixth shoreline site, Reserved Channel, would be filled in a gradient from shallow subtidal to high intertidal. This addition of atmospheric exposure could have a substantial effect on both the structure and abundance of the benthic community, in the high intertidal zone, although this would not necessarily be a deleterious impact. Intertidal habitat in Boston Harbor, once plentiful, is now primarily restricted to vertical faces of man-made materials. Few soft substrate intertidal flats remain in the Inner Harbor. Such habitats provide refuge and feeding habitat for juvenile finfish, as well as permanent habitat for sessile species such as soft-shell clams. Therefore, the partial fill scenarios could provide a beneficial increase in habitat diversity (particularly for finfish) in Boston Harbor.

Use of the Subaqueous B and E sites would also require raising the elevation of the substrate such that water depths would be shallower than existing conditions. In these cases, this could prove detrimental to finfish. In a shallow water environment, deeper areas are used to avoid temperature extremes. This is particularly true in the summer in Boston Harbor. Therefore, although the benthic impacts would cease after closure of either of these sites, impacts to finfish could be permanent.

Depth changes would also occur at Boston Lightship. In this case, the disposed dredged material and cap would form a mound on the substrate. Because the site is in deep water (150 ft), the height of the mound would be insignificant to surrounding
substrate. It is unlikely that the height of

the mound would affect finfish utilization of the site.

Substrate character could be permanently altered at some of the sites, including the shoreline sites, the in-channel sites, Subaqueous B, Subaqueous E and Boston Lightship. Closure or isolation of the disposed dredged materials at these sites would require capping with sediments not native to the disposal site. The three borrow pit areas, Spectacle Island CAD, Meisburger 2 and Meisburger 7, would each be capped using surface sediments from the excavated site.

The existing sediments within the shoreline sites are predominantly silty, and evidence suggests that they contain elevated concentrations of various organic and inorganic contaminants. The partial fill scenario would cover these sediments with dredged materials, isolating them from the Boston Harbor ecosystem in permanently. Dredged materials disposed at these sites would have to be confined to prevent their redistribution in the Harbor. A sand or clay cap would be used for this purpose. Sand would be more rapidly colonized by benthic infauna than would clay. Neither sediment would be particularly susceptible to adsorption of chemicals. Demersal finfish, especially winter flounder, would find a sand substrate more attractive than either silt or clay. Sand would also provide a more suitable habitat for *Crangon* (sand shrimp), an important food resource for finfish, that has been reported to occur in the Inner Harbor. These benefits would decline as silts from other sources settled out of the water column in these areas.

Use of a granular cap in the in-channel sites, or the two subaqueous sites, could be beneficial to finfish. Because the in-channel area appears to provide spawning and juvenile nursery habitat for winter flounder, this provision of preferred granular substrate would be especially beneficial. Those areas requiring armoring with rock, because of their vulnerability to vessel traffic, would be of reduced value to juvenile winter flounder but would increase benthic diversity which may be beneficial to other fish. Again, this benefit would diminish as sediments accumulated in the channels.

Capping of the disposal mound at Boston Lightship with sand would provide substrate similar to the natural conditions. A clay cap would be structurally different, and would probably provide a less valuable habitat than currently exists.

C. Subtidal Community Recovery

The likelihood that the structure of the bottom (subtidal benthic) community would re-establish is a function of the pre-project conditions and the types of alterations that would be made at the site. The benthic community at each site was selected as an identifier of site habitat quality because the organisms are sessile (and therefore site-specific) and are an important energy source for higher trophic levels. In general, areas that are in stressed environments prior to use as a disposal site have benthic communities adapted to that level of stress. As in the Inner Harbor, most benthic species in this type of environment are pioneers; they live in the surficial layers of the substrate. They also reproduce frequently (multiple

generations per year) and prolifically. Larval development may follow two strategies within the same species, ie., direct (avoiding the dispersion of planktonic larval development) or planktonic (allowing initial recruitment to the area). These characteristics allow these species to colonize recently disturbed sediments quickly and to recover from intermittent stresses. All areas examined for use as a disposal site for the BHNIP had some pioneering species in their benthic communities. However, the benthos in the Outer Harbor and the offshore areas had proportionately higher numbers of later successional stage species composed of longer-lived, subsurface dwellers. These later successional communities take longer to develop and require a more stable physical and chemical environment.

The ability of a site to recover its pre-project bottom productivity can, therefore, be related to the proportion of pioneering species comprising the community. Sites in the Inner Harbor are predominantly pioneering communities, therefore recovery would be expected to be the most rapid. Sites in the Outer Harbor exhibited a mixture of pioneering and Stage II benthic species. Therefore, some recovery would be apparent in the short term, but a longer period would be required to complete the recovery. All three offshore sites supported benthic communities that were primarily Stage II species with few pioneering species. These communities would take the longest to recovery.

4.2.1.4 Summary

Based on all aspects of direct impacts, the potential aquatic disposal sites are ranked (from least to greatest impact):

- In-channel
- Shoreline/partial fill
- Spectacle Island CAD, Meisburger 2, Meisburger 7, Boston Lightship
- Subaqueous B, Subaqueous E
- Shoreline/fast-land

The in-channel alternative is ranked as having the least direct impact because this alternative would be confined entirely within the footprint of the navigation improvement dredging. Also, the proposed capping would improve the physio-chemical conditions of the substrate, and biological recovery would be expected to be rapid. While partially filling the shoreline sites would satisfy the last two concerns, their location outside the proposed dredge area would result in an increase in the total impact area for the project.

4.2.2 Indirect Impacts

Indirect impacts would encompass those effects that occurred beyond the boundaries of the disposal site (and mixing zone) as a result of the implementation of a particular disposal scenario. These effects include changes in water quality, or effects on marine biota or habitats.

4.2.2.1 Water Quality Effects

Water quality impacts caused by the disposal of dredged materials were examined in several ways. The mixing zone is of primary regulatory interest under the Clean Water Act and the Water Quality Certification Regulations for both state and federally regulated waters, although it is not defined quantitatively in the regulations. Pollutant-transport and ADDAMS models were used to identify mixing zones for the potential disposal sites. In this analysis, for state-regulated waters, the mixing zone was identified as the area outside of which the chronic water quality standards are met. For sites outside of state-regulated waters, the mixing zone was defined as the site boundary outside of which water quality standards would be met four hours after a disposal event, the typical standard used for open-water disposal sites. For state water quality requirements, the mixing zone analysis focussed on the period immediately following each disposal event. The more typical water quality condition for this project is reflected in a scenario of multiple-day disposal events. Model results indicated that this scenario would cause steady state water quality conditions to be reached after an extended period of repetitive (daily) disposal events. Maximum concentrations based on this scenario were also modelled. Results of these analyses are detailed in Appendix F.

Disposal of silty dredged materials in aquatic systems tends to result in dispersion of about 5% of the sediments away from the point of disposal. Local hydrodynamics, operational schedules, and the volumes of material disposed determine whether repeated disposal events would result in an undesirable concentration of suspended sediments. This effect has been modelled using a pollutant transport model based on the ADDAMS model (STFATES); results are detailed in Appendix F. There is no regulatory criterion for Total Suspended Solids (TSS) against which to compare these results. However, other dredging projects in Boston Harbor have been required, through permit conditions, to prevent TSS from exceeding 50 mg/L (including ambient loads). A criterion of 50 mg/L was used to determine the TSS mixing zone for each potential disposal site for the BHNIP.

Physical handling of dredged materials can cause some chemical changes, particularly dissolution of contaminants bound to sediment particles. This effect is generally quite limited. Elutriate testing provides an indication of this effect. Elutriate tests performed on actual sediment samples from the channels proposed for dredging showed that mercury, copper and PCBs could be released from sediments descending through the water column at the disposal site. Concentrations of metal in addition to naphthalene (a PAH compound that represents PAHs most likely to be in the dissolved, as opposed to particulate, phase), that would result from the proposed disposal event schedule were modelled using the pollutant transport model described for TSS. Resulting concentrations were added to ambient concentrations and then compared to chronic-level water quality criteria (from USEPA 1986). Of these parameters, PCBs exhibited the greatest potential to be released into the water column. Model

results indicate that the chronic water quality criterion for PCBs (0.03 ppb) would not be exceeded outside the TSS mixing zone at any aquatic site.

A third potential source of short-term water quality impacts is loss of sediments to the water column when the disposed "mass" of dredged materials encounters the substrate. The likelihood of sediment rebound was evaluated using STFATES (Appendix F). This effect could conceivably occur during each disposal event. The primary effect of sediment rebound would be release of additional silt into the water column. Model results indicated that the release of sediments back into the water column would be negligible.

Comparison of water quality effects among sites can be made based on the size of the mixing zone required to meet State standards for Water Quality Certification. The state standards require minimization of the mixing zone around a dredging or disposal operation and the avoidance of impacts to migration routes and other impacts to resources. Mixing zones for each of the potential aquatic disposal sites were identified for total suspended solids (which represents an absolute load to the water body) and PCBs (the parameter whose predicted levels from disposal alone, in addition to ambient levels, are closest to the chronic water quality criterion). For the in-channel locations, the models also included input of these parameters from nearby dredging operations; the only disposal alternative at which this combined effect could happen.

Mixing zone models assumed disposal would take place near high tide to avoid buildup of undesirable constituents (TSS, PCBs). This schedule restriction would be part of the dredge management plan. Because there has been no numerical standard established for total suspended solids, a value of 50 mg/L, based on other recent Harbor dredging projects, has been used in this analysis as the critical limit for the mixing zone. The PCB analysis used the federally-established chronic water quality criterion of 30 ng/L (0.03 ppb).

In each case, the mixing zone needed to meet total suspended solids concentration goals would be larger than for PCBs (Table 4-3). Under worst-case conditions (an anticipated 14-day period of 6,000 to 10,000 cy disposal per day), the area needed for mixing for the in-channel alternative would range from 12.4 (TSS, Mystic River) to 30.0 (TSS, Chelsea River) acres. In each case, the shape of the mixing zone would reflect tidal current characteristics. In general, the shape of the mixing zone would be oriented along the predominant ebb tide direction. Width would be controlled by current velocity. Mixing zones in the Inner Harbor areas would be elongated, while those in the Outer Harbor, reflecting the more open conditions, would be more square. This aspect is important in examining potential impacts in the Inner Harbor. Mixing zones in the Outer Harbor sites (7.7 - 10.4 acres) are similar to the offshore (about 10 acres) sites.

Typically, at open water disposal sites, the boundaries of the mixing zone are defined as the boundaries of the site. In waters

under federal (Sec. 103) jurisdiction, the acute water quality criteria must be met outside the disposal site (i.e., the mixing zone) within four hours following a disposal event. The ADDAMS model results indicated that this condition could be met at the Meisburger 2 and 7 sites and the Boston Lightship site. The estimated footprints of these sites range from 86 to 121 acres; and the mixing zone would not extent beyond this area.

Modeling of repetitive disposal events (Appendix F) indicated that none of the aquatic disposal sites would experience chronic water quality violations over the duration of the disposal. Disposal activities at the shoreline sites, whether partially or totally filled, would not affect water quality during the construction phase.

The modeling results suggest that there would be spatial (size) differences in the mixing zones at each site, but that shoreline resources should not be exposed to contaminant levels that exceed chronic water quality criteria. It also appears that while some portion of the waterway would be disturbed during the disposal events, blockages of anadromous fish migratory routes would not likely be a problem. Comparing sites, based on the size of the mixing zone, would result in the following ranking (smallest to largest mixing zone):

- Spectacle Island
- Subaqueous E
- Meisburger 2, Meisburger 7
- Boston Lightship, Subaqueous B
- Mystic River
- Inner Confluence
- Chelsea River

4.2.2.2 Site Stability

The use of a site for disposal of dredged materials could have long-term impacts if the prevailing hydrodynamics (especially bottom currents) caused resuspension of the sediments. Normal tidal currents, wind or storm generated waves and vessel activity (propeller wash) can all affect the magnitude of bottom currents. The predominance of each of these factors varies among the sites being evaluated for disposal of dredged materials. Bottom currents in excess of 20 cm/sec (0.7 ft/sec) can resuspend and transport noncohesive silt (Gross, 1977). The cohesiveness of Boston Harbor surface sediments suggests that they would reach the bottom in clumps, and might require a slightly higher bottom current to induce resuspension (in the 30-50-cm/sec or to 1.6- ft/sec range). This effect was examined using the LTFATES model developed by the US Army Corps of Engineers Waterways Experiment Station (see Appendix F for details). Results were used to predict the likelihood of long-term transport of dredged material from the disposal site, and therefore the resulting need for a cap on the site to prevent such transport, and the likelihood that the cap would be successful.

Factors affecting site stability (as presented in Attachment 1 and Appendix F) are summarized in Table 4-4. The seriousness of each source of impact is a function of its frequency and magnitude, the likelihood of catastrophic failure, and the types of mitigative actions during and after construction that would be feasible at each site. Site design is also an important factor in determining site stability. This

issue was evaluated for construction and post-construction phases for each site.

A. Project construction

During construction, only the shoreline fast-land and partial fill scenarios would be completely protected from potentially erosional forces because the bulkhead would isolate these areas from the Harbor. The sites that would be exposed to erosion from tidal currents would be at the greatest risk because of the frequency (as often as once to twice daily) and breadth of these forces. Propeller wash effects, on the other hand, could occur as frequently as one to several times per day, but in limited areas. Storm events would generally be of lower frequency (variable among sites from once to many times per year in susceptible areas) and therefore could be dealt with on a case-by-case basis. While a cap could be protected with armoring, in the long term it would generally be difficult to protect the site completely during construction.

Subaqueous B would be particularly vulnerable because it could be disturbed by tidal currents, ship passage, and one-year storm events. Both Subaqueous E and Spectacle Island CAD would be exposed to tidal currents and storm and wind generated waves. In fact, Spectacle Island CAD could be affected by storms much more frequently than once per year. Additional studies would be necessary to confirm the severity of this effect and to determine whether engineering solutions would be available. The three offshore sites, Meisburger 2, Meisburger 7 and Boston Lightship, would be susceptible to disturbance by storms (but not to other factors such as propellor wash) during construction. The potential to construct Meisburger 2 or 7 in cells would enhance the ability to implement protective measures such as interim capping to secure the site in response to predicted storm events. This would be less easily accomplished at Boston Lightship because the entire disposal mound would have to be secured, although the greater water depths at BLS indicate that a more severe, and less frequent, storm would be necessary to affect this site. Portions of the in-channel locations could be exposed to vessel-generated currents routinely. This situation could be minimized by construction management such as scheduling the use of the most vulnerable areas during periods of lowest ship traffic (i.e., avoid periods when liquified natural gas (LNG) tankers are expected), implementing navigational restrictions, and providing physical barriers such as silt curtains around the disposal site. Stability of the shoreline sites would not be affected by these factors during construction.

B. Post-Construction Cap Failure

Because of its mound configuration and frequency of potential weather events capable of affecting it, the Boston Lightship would be at a relatively high risk of failure. The higher frequency of weather events that could affect Spectacle Island CAD would place it at a similarly high risk for failure. Although weather disturbances would be less frequent at Subaqueous B and E, the frequency of

potential disturbance by tidal currents in addition to the storm currents would increase the risk of site failure. Either site could be armored after closure if post-closure monitoring showed it was warranted.

The integrity of the partial fill shoreline sites would be dependent on being able to maintain sufficient geotechnical strength to prevent slumping after the bulkhead was cut off at MLW. While the slope would not be great at these sites, the disposed dredged materials would have a high water content that would initially be unstable. Stability would improve as the sediments became consolidated, although this could take a period of years. With the exception of the Reserved Channel, each of the shoreline sites is adjacent to a berth or channel and could be exposed to travelling or turning vessels. This would not be a problem for the fast land scenario.

The ability to construct the Meisburger 2 and 7 sites in multiple cells would reduce the risk of catastrophic failure during and after construction. Therefore, these sites are considered to be at lower risk of failure despite the potential for weather-related bottom currents to affect the substrate more than once a year.

Vessel traffic is the only factor that would be likely to disturb the substrate in the in-channel disposal sites. Because areas vulnerable to disturbance by propeller wash can be identified and armored, the in-channel areas face a lower risk of failure than other sites.

C. Summary

The risk of site failure differs among sites and between the construction and post-construction phases. During construction, the sites are ranked (from least to greatest risk):

- Shoreline-Fast Land or Partial Fill
- In-channel
- Meisburger 2, Meisburger 7
- Boston Lightship
- Subaqueous E
- Subaqueous B, Spectacle Island CAD

The shoreline sites would have the lowest risk of site failure during construction because the bulkhead would prevent exposure to erosive currents emanating from any source. In-channel locations were considered to have the next lowest risk because the only potential source of strong bottom currents (vessel traffic) would be limited to identifiable areas. Construction management techniques, including limiting the size of the exposed work face, to limit the period of exposure, can be implemented to minimize impacts.

The potential for post-construction failure (i.e., cap failure and release of disposed silts to the environment) would rank the sites (from least to greatest risk):

- Shoreline-Fast Land
- In-channel
- Meisburger 2, Meisburger 7
- Shoreline-Partial Fill
- Subaqueous E
- Subaqueous B
- Spectacle Island CAD, Boston Lightship

The shoreline (fast-land) alternatives would experience the lowest risk of post-construction failure beacuse the bulkhead would protect the disposed sediments from the influence of all currents. Because the magnitude of the vessel traffic impacts in the Inner Harbor is more predictable than storm effects in other locations, protective measures are more easily identifiable and implementable for the in-channel locations than other sites; thus is ranked as having the record lowest risk.

4.2.2.3 Downstream Impacts

Use of aquatic disposal sites could impact downstream resources during site preparation, during disposal or after disposal. This analysis addresses the concerns of impacts during active site use and the potential impacts of post-construction cap failure at the site.

A primary mechanism for these impacts is the hydrodynamics of the disposal site. Because tidal currents predominate over other normal currents at all of the potential aquatic disposal sites for the BHNIP, "downstream" includes the areas influenced by either flood or ebb tides in relation to the disposal site. As indicated in the preceding section, hydrodynamics govern whether material (suspended sediments, including bound or dissolved contaminants) could be transported from the disposal site. Modeling done to evaluate impacts to water quality provides insight into the likelihood that biological resources and commercial users of water in the sphere of influence of the disposal site would be affected by use of the site.

Impacts arising during site preparation or disposal would constitute short-term effects. Impacts arising after closure of the disposal site would constitute long-term impacts.

A. TSS Concentrations

Environmental concerns about dredging and aquatic disposal events include the potential for increased total suspended solids (TSS) to interfere with the vital functions of aquatic organisms (e.g., clogging of gills) as well as seasonal movements (e.g., fish migrations). There is also concern that if concentrations of any contaminants released from the sediments exceeded chronic-level water quality criteria, organisms exposed to those waters could experience sublethal or toxic effects. Because they are sessile, benthic organisms would be at a greater immediate risk of this exposure than motile finfish.

The distribution of TSS around the disposal site is a function of both local hydrodynamics and the settling velocity of the suspended particles. Silt settles, in a static environment, at a rate of 0.01 ft/sec (0.3 cm/sec). Review of the STFATES model output can, therefore, provide an estimate of the areas most likely to experience sedimentation of the dredged material escaping the disposal site during descent. Excessive quantities of settling silt could smother sessile organisms such as soft-shell clams and attached (demersal adhesive) eggs of finfish species such as winter flounder. Confined silts would also return those contaminants adsorbed to the sediment particles to the local

environment. Depending on the quality of the existing environment, this could increase the potential for contaminant uptake through dermal contact (e.g., winter flounder) or ingestion (by any benthic feeding species) or, alternatively, keep conditions or the level of risk the same if surrounding habitats reflect degraded sediment quality.

Downstream resources of concern can be categorized into two groups: biotic and human use. Based on site-specific investigations (see Attachment I), five biotic resources (anadromous fish, winter flounder, lobster, soft-shell clams and benthos) were identified among the 15 potential aquatic disposal sites. Three human uses (fishing grounds, water intake and swimming areas) were identified. Each potential disposal site was evaluated in terms of whether its use could affect any of these resources either during project construction or as the result of post-construction cap failure (Table 4-5). The silt dispersal from the site during each disposal event (vagrant silt) would be the primary source of these potential impacts.

Anadromous fish passage through the Inner Harbor could be affected by degradation of water quality, in particular increased suspended solids (TSS). Typical disposal operations in the In-channel sites would cause areas of temporarily elevated TSS, but these areas would extend only part way across the entire width of the channel. Therefore, it is unlikely that disposal would interfere with passage of anadromous fish through the Mystic River.

B. Project Construction

With the exception of the shoreline sites, only sediments deposited downstream would be detectable immediately adjacent to any disposal site during construction. Because all disposal at the shoreline sites would be behind bulkheads, shoreline sites would be unlikely to have any definable effect on downstream resources during construction.

The areas affected during each disposal event at all other sites would generally be directly seaward of the barge, assuming that disposal was restricted to periods around high tide to optimize the mixing zone size (see preceding section). The magnitude of dredging in the BHNIP and the design of each disposal site would necessitate frequent repositioning of the barge within the site, thereby reducing the likelihood that any specific downstream area would be subject to repeated sedimentation. Simple geometry dictates that the larger the footprint of the disposal site, the less frequently vagrant silt would settle outside the site boundaries. In the in-channel alternative, the sediments settling downstream of the disposal site would be similar to the existing sediments. Excessive siltation could increase mortality of organisms on the substrate, including winter flounder eggs in an area about 1.1 acres in size adjacent to each disposal cell. Site configuration determines, however, that the area downstream of most disposal cells, except those in the Inner Confluence, would be impacted either by the dredging or disposal aspects of the BHNIP. Therefore, downstream sedimentation would not expand the impact footprint of this alternative by a substantial amount.

Potential disposal sites located in the Outer Harbor or offshore would not be adjacent to areas otherwise impacted by the BHNIP. Therefore, any downstream sedimentation outside the disposal area would expand the impact footprint of the particular disposal alternative. In addition, sediments of the Outer Harbor and offshore sites contain lower levels of contaminants than those dredged from the Inner Harbor. Disposal at any of the Outer Harbor sites would cause sedimentation on *Ampelisca* beds, indirectly affecting winter flounder feeding habitat. The smaller footprint of Spectacle Island CAD would allow a relatively larger proportion of the vagrant silt to settle outside the site boundaries than either Subaqueous B or E. Sedimentation outside the boundaries of the Meisburger 2 or 7 or Boston Lightship sites could affect Stage II benthic communities and the groundfish and lobsters that they support. As with the Outer Harbor sites, the smaller the footprint of the disposal site, the more likely vagrant silt would be to settle outside the boundaries. Therefore, Meisburger 2 would be likely to affect a larger area outside its direct impact footprint than either Meisburger 7 or Boston Lightship.

C. Post-Construction Cap Failure

The preceding section on site stability addressed the factors that could influence cap failure at each disposal site. The severity of cap failure is a function of the likelihood that it could occur and the resources that could be affected if it did occur.

Using these criteria, the shoreline sites and the in-channel sites would have the lowest potential impact from post-construction site failure. Vessel activities would be the most likely cause of loss of site integrity. However, analysis of traffic patterns has been used to identify areas vulnerable to disturbance so that additional protective measures could be implemented (i.e., "armoring" of the substrate with project rock material). While the dispersal of disposed dredged materials from these sites should be avoided, it would not change the character of the downstream areas substantially.

The three potential disposal sites in the Outer Harbor would face a relatively high risk of cap failure after construction. Each, and particularly the Spectacle Island CAD, would be vulnerable to bottom currents generated by high-frequency (one-year or less return period) weather events. In addition, both Subaqueous B and E could be disturbed by normal tidal currents. Dispersal of BHNIP sediments disposed in any of these Outer Harbor sites into other areas of the Outer Harbor could have deleterious impacts on several biological or human use resources by introducing contaminant-bearing sediments into an area of improving environmental quality.

Because of their greater depths, the three offshore sites would have a reduced potential of experiencing cap failure than the Outer Harbor sites, although they could be affected by storm events. Like the Outer Harbor, however, release of BHNIP sediments from these disposal sites would introduce them into an area of

higher sediment quality. The biological resources that are present at these sites reflect the physical and chemical quality of the sediments, and would, therefore, be more severely affected by contact with contaminated sediments than in the Inner Harbor.

D. Summary

Project construction would have limited impacts on downstream resources. The sites could be ranked into two categories under this effect (from least to greatest effect):

- all Inner Harbor locations
- all Outer Harbor and offshore locations

This ranking reflects the same rationale as the ranking for site stability with the additional factor that biota in the Inner Harbor are already adapted to the quality of the sediments proposed for disposal. Post-construction cap failure, in which project sediments were released into the local environment, could have broader impacts that would be more distinct among sites. This evaluation ranked the sites from least to greatest effect:

- In-channel, Shoreline - Fast-Land, Shoreline - Partial Fill
- Meisburger 2, Meisburger 7, Boston Lightship
- Subaqueous B
- Subaqueous E, Spectacle Island CAD

Again, this ranking reflects the rationale described for site stability and the exisitng character of the biota at the potential disposal sites.

4.2.2.4 Biological Exposure Potential

Exposure of organisms to contaminants, associated with (or dissociated from) the dredged materials disposed at any of the potential disposal sites, could occur through either water column or benthic routes. Exposure could occur within or beyond the disposal site boundaries, depending on site characteristics. Data from elutriate, toxicity and bioaccumulation testing were used in conjunction with pollutant transport modeling to evaluate the relative magnitude of these effects. Application of these results to each site must take into account the quality of the environmental conditions at or adjacent to the disposal site.

A. Water Column Exposure

Water column exposure is a function of areal extent, duration of exposure and contaminant load. A simple approach to evaluating water column exposure is an extension of the pollutant transport models described in the preceding section and applying these results to species of concern for each disposal site. The focus would be primarily on pelagic and suspension-feeding species. Because of the transient behavior of both water column biota and constituents released into the water column during the disposal process, the potential exposure would be limited. Although demersal finfish species and benthic

surface deposit-feeding species would also be exposed to the water column, direct contact with contaminants in the substrate is likely of greater concern for these species.

Disposal of dredged materials through the water column is not expected to result in violations of chronic water quality criteria outside the mixing zone, regardless of the location of the disposal site. While there are differences in the size of the mixing zone for each site, differences among the sites, in terms of exposure of pelagic organisms to contaminants outside these zones, would not be expected.

B. Substrate Exposure

Exposure of bottom-dwelling (benthic) organisms can be viewed as a simple function of footprint of the disposal site, exposure duration and contaminant load (relative to existing conditions). Although population data are available for benthic communities, use of individual sites by finfish and other motile species is more difficult to quantify because many species exhibit both lifestage, seasonal and small-scale spatial differences in distribution. There are no regulatory criteria currently in place against which to evaluate the sediment concentrations.

The potential for toxicity and bioaccumulation of contaminants caused by exposure to the BHNIP sediments was evaluated for the DEIR/S (Appendix C of DEIR/S). Exposure to both berth and channel sediments resulted in increased mortality of the sensitive test species, *Ampelisca abdita* (amphipod) whereas both *Macoma nasuta* (clam) and *Nereis virens* (polychaete) exhibited no signs of increased mortality. By extension, then, it would be expected that if disposed sediments were left exposed, sensitive species (e.g. *Ampelisca abdita*) would be unable to colonize them, whereas potentially less sensitive (e.g. polychaetes and clams) species might. The COE/EPA tests were run with adult organisms, not larvae or juveniles, which are often more sensitive lifestages. These results are not completely representative of the actual environmental effects of the sediments, as subtidal areas in the Inner Harbor do support a variety of benthic infaunal species, occasionally including sensitive taxa such as *Ampelisca*.

Bioaccumulation was measured in clams and polychaetes. Test results indicated that benthic organisms that colonized exposed sediments dredged from berths would be likely to bioaccumulate metals (lead and mercury) and organic contaminants (PCBs and 12 of 16 priority pollutant PAHs) from the sediments, providing a route for ingestion by demersally-feeding finfish and epibenthic invertebrates. Exposure to channel sediments, however, would likely result in bioaccumulation of cadmium, chromium or lead, but not organics, by deposit feeders.

A similar analysis could be applied to downstream areas that would be expected to experience sedimentation of silts dispersed during the disposal events. The STFATES models were used to predict downstream areas that would experience sedimentation of the vagrant silt (i.e., that

lost to the water column during a disposal event) and the thickness of the silt layer. Although hydrodynamic conditions could cause this layer to be resuspended and retransported, the areas identified by this analysis would be likely to experience sedimentation repeatedly during the disposal process. Areas predicted to receive a silt layer thicker than I cm after a single disposal event were considered to have the potential to expose biota to contaminants if the site initially had lower levels of contaminants than the BHNIP sediments. In sites where the benthic community was primarily surface dwelling, this quantity of siltation could smother the organisms.

The difference in potential biological exposure to contaminated sediments among the sites is a function of the footprint and the length of time the site is uncapped, as well as the sediment and benthic quality of the adjacent areas. Finfish would be less likely to forage in areas of relatively degraded sediment and benthic quality if better resources were typically available (i.e., if conditions caused by disposal contrasted markedly with the normal conditions). Beyond the site (i.e., downstream), potential biological exposure is a function of these factors and the likelihood that vagrant silt would settle.

C. Site Footprint

The potential disposal sites fall into three categories of footprint and exposure period during construction. The shoreline sites would be completely isolated from Boston Harbor during construction, resulting in no exposure to marine organisms. The in-channel and Meisburger sites could be constructed in cells, leaving only a portion of the total footprint exposed at any one time. This construction approach would create frequent disturbance in the cell footprint throughout its period of use, discouraging finfish from entering the area. If finfish were to spend time associated with the disposed silts, this would be more likely to occur at the in-channel locations because of the similarity between the BHNIP sediments and the natural conditions.

Development of the Subaqueous B, Subaqueous E, Spectacle Island and Boston Lightship sites in cells would be more problematic. Therefore, dredged material could be continuously exposed throughout the entire dredging project. The quantity of material to be disposed would require a large footprint at each of these sites. Therefore, although finfish would avoid the area where disposal was actively occurring, they could spend time in areas that had been filled but not yet capped. This likelihood would be offset by the fact that the disposed sediments would be dissimilar to the naturally-occurring sediments at Boston Lightship. Finfish seeking cooler temperatures during summer months could be attracted to the deep pit to be constructed at Spectacle Island. Since surface sediments near Spectacle Island contain quantities of silt, the differences between the BHNIP sediments and natural conditions might not be immediately distinct. Therefore, there is some risk of increased exposure to finfish near Spectacle Island. Finally, unless a the disposal site was decked over immediately, the shoreline/fast-land

alternatives would resemble ponds along the waterfront. This could attract birds.

D. Downstream Impacts

With the exception of the shoreline sites, where virtually no silt would be lost to the water column during disposal, the aquatic sites would not differ in the total quantity of dredged material lost to the system (about 3-5% of the total released from the barges). The differences among the sites would lie in the dispersal of the vagrant silt. The volume of water (roughly represented by the depth of the site) available to dilute the sediments, and the typical current regime, determine the concentration of suspended materials, and the distance from the site this material is dispersed, before it reaches the substrate. Thus, deeper sites and sites with regularly fast currents would exhibit lower concentrations of suspended materials. These currents would cause sediments to be dispersed farther. Concentrations of sediments on the substrate where they would be deposited at these sites would be lower than at sites from which dispersion was reduced.

The in-channel, Subaqueous B and Subaqueous E sites would each be exposed to regular periods of elevated currents. In-channel sites would be exposed to ship traffic while Subaqueous sites would be exposed to tidal currents. These currents would tend to prevent permanent deposition of vagrant silts. Because of the layout of cells in the three channel areas, most material that dispersed from the actual disposal activities would settle on an area that had recently been dredged or was soon to be dredged. Therefore, there would be little increased downstream impact and little increase in biological exposure potential. Similarly, the dimensions of Subaqueous B and E would allow vagrant silt from a large portion of the disposal events to settle within the site boundaries.

The Meisburger, Spectacle Island and Boston Lightship sites would each have a higher potential for downstream biological exposure because typical currents would be more likely to allow sedimentation to occur, although most vagrant silts would settle within the disposal site footprint. As with the in-channel and subaqueous sites, the extent of downstream sedimentation would be limited by the dimensions of each site. The siltation is unlikely to be thick enough to smother existing benthic organisms. Finfish would not be deterred from foraging in these areas.

E. Summary

The likelihood of biological exposure to contaminated dredged materials in the water column would not differ much among the disposal sites, as indicated by the results of the water quality modeling. There would, however, be differences among the sites in terms of the potential for biological exposure to the substrate, resulting in the following ranking (from least to greatest potential):

- In-Channel, Shoreline-Partial Fill
- Meisburger 2, Meisburger 7, Shoreline/fast-land

- Spectacle Island CAD
- Subaqueous B, Subaqueous E
- Boston Lightship

Biological exposure potential would be lowest under the in-channel and partial-fill shoreline scenarios because the character of the disposed sediments would be similar to existing conditions at and adjacent to these sites.

4.2.3 Identification of The Least Environmentally Damaging Aquatic Alternatives

Table 4-6 provides a summary of the relative severity of the impacts discussed in the preceding section at the potential disposal sites. The in-channel disposal alternative was consistently ranked among those alternatives having the least impact. The partial-fill shoreline alternative was ranked among the alternatives having the least impact in most instances. Therefore, in-channel disposal or partial filling of shoreline areas would constitute the least environmentally damaging alternatives for aquatic disposal of dredged material unsuitable for disposal at the MBDS.

The In-channel disposal option would offer a distinct advantage over other sites because it would confine the disposal of sediments to areas that would be disturbed by the dredging for the BHNIP. Other advantages include the minimal downstream impacts and potential for biological exposure. These are both due to the similarity of the sediments proposed for disposal to existing conditions within this portion of the Harbor. The two most critical drawbacks to the use of these areas would be the size of the mixing zone and the effects of vessel traffic on site stability. Proper management of the disposal activities would be necessary to minimize these factors.

Because of the proposal to have dredging and disposal, at times taking place simultaneously in two in-channel locations, the mixing zone would be the sum of that in each in-channel location. While this sum would cause the total area needed for mixing to be larger than that needed in the Outer Harbor, it would represent a relatively small portion of each section of the Harbor. Operational controls, such as confining disposal to periods around high tide, would be instituted to minimize the size and character of the mixing zone. This would ensure that the mixing zone did not move upstream or spread across the entire width of the Harbor.

The effects of vessel traffic on site stability in in-channel locations can be controlled by construction and site closure methods. Areas most vulnerable to disturbance by vessel traffic have been identified. Construction of cells in those areas would need to be scheduled to avoid the once to twice monthly passages of LNG tankers because these vessels require the entire channel width for passage. Other vessels can maneuver under more restricted conditions, enabling the use of silt curtains around the disposal site to help confine the descent of disposal material. Capping of these areas could include a layer of rock to armor the sand cap, preventing future erosion of the cap.

Partial filling of the shoreline sites, particularly those located in the Mystic and Chelsea Rivers, would also have relatively few environmental impacts. Drawbacks to use of these sites include the fact that they are located outside the proposed BHNIP dredging footprint, and therefore extend the total project impact area, and site stability at the edge of each site nearest to the Harbor. With the exception of the Reserved Channel site, each of the shoreline sites is located adjacent to either an active channel or an active marine terminal and would, therefore, be subjected to bottom currents associated with vessel maneuvering. Filling these sites would elevate the substrate so that it could be subjected to even higher velocities than occur at the bottom of the channels once the bulkhead was cut back to the top of the fill (MLW). While the portion of each site nearest to the Harbor could be armored with rock, the risk of site failure would be higher than at in-channel sites.

The other sites examined would have greater impacts associated with dredged material disposal, in particular the introduction of a large mass of contaminated sediments to relatively undisturbed (Meisburger sites) or recovering (Outer Harbor sites, Boston Lightship) areas. Each of these sites faces more substantial risks to site stability than the Inner Harbor because sites of the potential severity of weather-generated bottom currents and the greater difficulty securing the sites against these occurrences. Even without such an event, recovery of the aquatic resources at any of these sites would be prolonged.

4.3 PRACTICABILITY ANALYSIS

This section evaluates the practicability of using each of the potential disposal sites shortlisted through the site evaluation process (see Chapter Three) by examining the following issues:

- Availability
- Permitability
- Constructability
- Logistics
- Monitoring
- Conflicts
- Capacity
- Cost
- Future Use

These issues are defined and discussed in the following subsections. These issues are often inextricably linked with one another. However, we have attempted to distinguish sites using these practicability criteria. Information on each site is summarized on Table 4-7.

Practicability is defined by the 404(b)(1) Guidelines as "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes." Under NEPA these factors may be included in the discussion for determining an agency(s)' environmentally preferable alternative. According to NEPA (40 CFR 1505.2(b)), "an agency may discuss preferences among alternatives based on relevant factors including economic and technical considerations and agency statutory missions."

The follow subsections discuss the short-listed sites in terms of the practicability concerns listed above.

4.3.1 Availability

4.3.1.1 Upland Sites

Availability is defined by ownership and jurisdictional control. It reflects whether a site is privately owned or within the public domain. Further, it considers whether use of each site is regulated primarily by state or federal regulations, or whether the site has special regulatory status. Sites privately or municipally-owned are considered to have low practicability because of the need to purchase the site. Sites within state or municipal jurisdiction are considered to have moderate practicability but may have complex permitting issues. Sites beyond state jurisdiction are considered to have high practicability because of somewhat less complex permitting. Special regulatory status could modify these ratings in either direction, although those sites whose special status reflected important environmental resources (e.g. ACECs) were eliminated earlier in the site selection process.

Of the upland (undeveloped) sites, Woburn and Squantum Point are owned by municipalities, Everett is owned by a public utility, and Wrentham is privately owned. For the lined landfills availability is not an issue since all have indicated a willingness to accept portions of the silt.

4.3.1.2 Aquatic Sites

In Massachusetts, coastal waters out to the three-mile limit are regulated by the Commonwealth. Use of these waters is controlled (through the Wetlands Protection Act, up to 80 feet below MLW) by the state and the municipality abutting them. Boston Lightship (and the Massachusetts Bay Disposal Site for parent material disposal) is the only site that falls strictly under federal jurisdiction. All other aquatic sites are within state waters, requiring review at the municipal, state, and federal level. Several of the shoreline sites (Amstar, Mystic Piers and Revere Sugar) and the in-channel sites (Mystic River, Chelsea River and Inner Confluence) are within the State's Designated Port Area, a status that supports water-dependent use (see Chapter Seven). The remaining aquatic sites are within State waters but have no additional regulatory classification. No distinction is made between the partial-fill and fast-land scenarios for the shoreline sites on this basis. Based on this criterion, the aquatic sites would be ranked for practicability, due to availability, as:

- Boston Lightship
- Amstar, Mystic Piers, Revere Sugar, in-channel (Mystic River, Chelsea River, and Inner Confluence)
- Little Mystic Channel, Reserved Channel, Subaqueous B, Subaqueous E, Spectacle Island, Meisburger 2, and Meisburger 7

4.3.2 Permitability

4.3.2.1 Upland Sites

This issue evaluates the complexity of the permitting process. It is partially related to the potential for repeated use of a particular site beyond the BHNIP. For inland and coastal sites, permitability issues are mainly tied to the need for the proposed disposal site to undergo review through the state's Solid Waste Siting Review and Designation process. The siting and permitting of a new solid waste facility in the Commonwealth of Massachusetts is a lengthy process. Initially an application for the suitability of the site must be submitted to the Massachusetts Department of Environmental Protection. The application must include: 1) documentation that the selected site meets the suitability criteria; 2) the engineering design report; 3) the landfill operations and management plans; and, 4) certification that the applicant has complied with the Massachusetts Environmental Policy Act. The application is then reviewed by the DEP and public hearings are held to obtain comments from the affected community.

The entire process, including site investigation, landfill design and permitting, may require three to five years. The actual time required for the permitting of a facility may vary from this estimate, depending on the complexity of the site conditions and environmental constraints, time required by the DEP to review the documentation and the level of public concern. Thus the siting process for Solid Waste Facility designation for this project could be a serious limitation for the BHNIP given the proposed 1997 starting date.

Given the difficulty of siting and permitting a disposal site, the land-based options may be more suitable for future maintenance material. The upland sites therefore are considered to be low in practicability for the permitability criterion. Permitability is a relatively minor issue for the three lined landfills sites because the landfills are already permitted to receive special waste. All would need to have the silt characteristics reviewed by the State and municipalities prior to acceptance. Their rankings for upland sites for ther permittability criteria are:

- Lined Landfills
- Remaining Upland Sites

4.3.2.2 Aquatic Sites

For aquatic sites, their use may require further study that would extend the period needed for permitting. This factor would cause a site to have low practicability for the BHNIP (although it could still be practicable for future projects). Another issue would be whether use of a particular site would result in the loss of aquatic habitat. Since this loss would potentially be mitigable, such sites would be considered to have moderate practicability for the BHNIP and future projects. Sites likely to be suitable only for a one-time use, and not resulting in the permanent loss of aquatic habitat (whether or not mitigable), are rated as having higher practicability for the BHNIP.

Three sites, Meisburger 2, Meisburger 7 and Boston Lightship, have capacity well above that needed for the BHNIP and would be likely candidates for repeated use for disposal once approval for this use was

given. Therefore, regulatory commenters on the DEIR/S have indicated that it would be necessary to conduct formal site designation investigations prior to granting permits. The formal site designation process for open water disposal sites is a minimum of two years long. Given the importance of these sites (the Meisberger sites, in particular) as commercial fishing habitat, this process could take significantly longer. These factors would place delays on the BHNIP that would jeopardize the necessary federal funding for the project.

The fast-land scenario for the five shoreline sites (Amstar, Cabot Paint, Little Mystic Channel, Mystic Piers and Revere Sugar) would result in the permanent loss of aquatic habitat, thus being a direct conflict with 404(b)(1) criteria and made more problemmatic by the lack of available compensatory resource areas for mitigation in the Harbor area. Permitting the remaining aquatic disposal scenarios is highly practicable.

Review of permitting issues results in the following ranking of aquatic sites (from high to low practicability):

- In-channel (Mystic River, Chelsea River, Inner Confluence)
- Partial-fill shoreline (Amstar, Cabot Paint, Little Mystic Channel, Mystic Piers, Reserved Channel, Revere Sugar), Subaqueous B, Subaqueous E, Spectacle Island CAD
- Fast-land shoreline (Amstar, Cabot Paint, Little Mystic Channel, Mystic Piers, Revere Sugar)
- Meisburger 2, Meisburger 7, Boston Lightship

4.3.3 Constructability/Complexity of Engineering

4.3.3.1 Upland Sites

The degree of complexity required to site, design, build and operate the dewatering facility is high for all of the upland sites. The primary engineering and operating constraint would be the dewatering system, which would need to be constructed on the Boston waterfront and used to treat the silt prior to hauling to any of the upland sites (See Section 4.1.1.1).

The sheer volume of material (200,000 cy proposed for upland disposal) is extreme for most dewatering technologies, with the exception of air drying, which has a large acreage requirement and is seasonally limited. The proposed belt filter presses, which could be used in combination with air drying, is standard technology, but is slow and maintenance intensive.

Additionally, a disposal facility constructed at any upland site would essentially equal a lined landfill with a liner; berms; underdrains; leachate collection system; pre-,mid-, and post-monitoring; capping; and a long-term site closure plan. Site-specific analyses to evaluate risks to the environment would be required, such as assessment of the stability and current contamination levels of the closed, partially capped landfill underlying Woburn, and the limits and hydrologic connections of the Zone II aquifer at Wrentham. For this practicability analysis, it is assumed that all four upland sites have a high degree of complexity, and therefore a low practicability for the Project.

The lined landfills are also rated low in practicability with respect to engineering complexity because of the need to dewater the silts at the Harbor prior to transporting

to the landfill. However, all other construction and operation concerns are eliminated since the disposal facilities already exist.

4.3.3.2 Aquatic

Constructability or complexity of engineering concerned with the techniques needed to prepare and close sites, are generally rather simple for the aquatic sites. Site preparation could include dredging (in-channel and borrow pit sites); dike construction (subaqueous sites); bulkhead construction (shoreline partial-fill or fast-land scenarios with weir structures to allow drainage); or no site preparation needed at all (Boston Lightship).

All alternatives, except the fastland scenarios, would require capping in a submerged environment. While placing cap material in shallow conditions (e.g., in-channel, shoreline, subaqueous, and Spectacle Island sites) is a proven practice, commenters on the DEIR/S raised concerns about whether this could be successfully demonstrated at deeper sites (Meisburger 2, Meisburger 7, and Boston Lightship).

Compared to upland sites, practicability of site preparation and closure of aquatic sites would be high for shallow sites (i.e. In-channel, Spectacle Island, Subaqueous B and E) and lower for deep sites such as Boston Lightship, Meisburger 2 and 7).

4.3.4 Logistics

4.3.4.1 Upland Sites

Logistical concerns include the number of handlings of the material to be disposed, hauling distances, and rate of disposal as controlled by the slowest factor (e.g., trucking, dewatering, dredging, avoidance of sensitive receptors, etc.). For the upland sites, the material will be handled several times:

- off-loading for dewatering,
- working during the dewatering process,
- loading onto trucks for hauling,
- spreading at the disposal facility

Each handling step involves planning; incurs an increased cost in time and equipment; and represents a potential risk to the environment through accidents.

Hauling distance also affects the practicability of the upland sites. Two coastal sites are in close proximity to the BHNIP via barge. Everett is on the Mystic River, and Squantum Point is in Boston Outer Harbor at the mouth of the Neponset River. In contrast, use of the two inland sites, Woburn and Wrentham, would require truck round-trips of 1 and 2 hours, respectively. Depending on the size of the truck fleet used, the dredging or dewatering rate could be limited by the hauling rate. The size and speed of the truck fleet will be dependent on issues such as restricted operating hours (due to noise or air quality effects) in areas of sensitive receptors, existing traffic volumes, either in Boston or at the receiving town, and cost of operation.

Lined landfills have similar logistical issues as the upland inland sites, having both multiple handling needs and trucking requirements. Round-trip trucking times to the Plainville, Fitchburg/Westiminster, and E. Bridgewater landfills are estimated as 2, 3, and 1 hours, respectively.

The upland sites and lined landfills are rated relatively low in logistical practicability due to the multiple handling required as a result of dewatering and hauling. Woburn and Wrentham are especially problematic because their distances from the Harbor could ultimately slow the BHNIP dredging rate.

4.3.4.2 Aquatic Sites

The logistics of disposal operations at aquatic sites are simpler than with land-based sites because there is no need for dewatering prior to transport to the disposal site. Among the aquatic sites, handling is most complex for the shoreline sites because site configuration requires that silt be offloaded from barges by crane rather than dumped from the bottom of the scow. The sites that could be developed in cells (in-channel and Meisburger sites) or require no preparation (Boston Lightship) would experience the shortest delays before being available for disposal.

The proximity of the in-channel disposal sites to the dredging operation make this alternative the most highly practicable of those examined. On the other hand, the distance of the Boston Lightship and Meisburger sites from the dredging, while not enough to constrain the production rate, complicate their use logistically by necessitating the use of larger barges, traversing longer stretches of commercially used waterways, as well as the potential for more weather-related delays (and risks). Site preparation at sites such as Spectacle Island and Subaqueous B and E would be more extensive, potentially resulting in the need to stockpile silts temporarily. As these sites are located in the Outer Harbor, barges would need to traverse virtually the entire length of the Harbor's waterways.

Therefore, Boston Lightship, Meisburger 2 and 7, Subaqueous B and E and Spectacle Island are considered to be moderately practicable with respect to logistics. In-channel and shoreline sites are rated highly practicable.

4.3.5 Monitoring

4.3.5.1 Upland

Monitoring of the silt disposal process (for both upland and aquatic sites) will be required both during and after disposal to ensure that the silts are adequately contained and are posing no undue risk to the environment. For disposal at the upland sites, monitoring would likely be required at the dewatering facility as well as the disposal facility. For dewatering, monitoring would include Harbor and air quality monitoring and would cease at the end of the dewatering phase. At the disposal facility, monitoring would likely include groundwater and surface water sampling for leachate leakage, air quality, cap and berm stability and leachate characteristics. These monitoring needs are standard in the landfill industry and therefore represent no technological hurdles but are costly. Monitoring at Everett and Woburn may be somewhat complicated by potential contamination from an adjacent 21-E site at Everett and the closed on-site landfill at Woburn.

The lined landfills have monitoring programs currently in place for accepted wastes. Project monitoring needs for these sites would be limited to Harbor and air quality monitoring at the dewatering facility. This monitoring would cease at the end of the dewatering phase of the Project.

The practicability of monitoring at the upland sites is moderate due to the

standard, but extensive nature of the monitoring that is likely to be required. At the landfill sites, the monitoring practicability is high because of the limited monitoring needs at the dewatering site.

4.3.5.2. Aquatic Sites

For disposal at aquatic sites, monitoring would likely be required to verify compliance with the projected mixing zone during disposal operations. Post construction monitoring would likely be required to confirm the integrity of the cap or bulkhead and to verify the recovery of biological resources.

The practicability of monitoring at the aquatic sites is moderate at the offshore and Outer Harbor sites because events that could affect the integrity of the cap would be infrequent, although potentially severe in nature. In addition, monitoring would be affected by the more complex structure of the existing biological resources at these sites indicating that the period of recovery would be prolonged. In contrast, the practicability of monitoring sites in the Inner Harbor would be high because the frequency of occurrence of factors that could influence site stability would be high (allowing rapid confirmation of cap integrity), and because existing biological resources are adapted to this stressed environment and would be expected to recover rapidly. Therefore aquatic sites are ranked with respect to monitoring as:

- High practicability - In-channel, shoreline (partial-fill and fastland)
- Moderate practicability - Boston Lightship, Meisburger 2, Meisburger 7, Spectacle Island, Subaqueous B and Subaqueous E

4.3.6 Conflicts with Other Activities

4.3.6.1 Upland

The upland sites are all located on inactive lands. No known projects are proposed at Everett or Woburn. There has been mention of a potential industrial park usage at the Wrentham site. The Town of Woburn has expressed possible interest for assistance by the BHNIP in permanently closing the partially capped landfill currently on the Woburn site. At Squantum Point, the Metropolitan District Commission has plans for a park on a portion of the proposed disposal site. The construction of the disposal facility would require coordination with the MDC to ensure the needs of both projects can be met. It is likely that a park can be accommodated on the site once the disposal facility was closed and capped.

Use of the lined landfills does not interfere with any known project.

There is a high practicability for all lined landfills, Everett, Woburn, and Wrentham; and moderate practicability for Squantum Point because of the proposed MDC park.

4.3.6.2 Aquatic Sites

There are three basic areas of potential conflict between aquatic disposal activities and other site uses: public works projects, fishing activities and navigation. Of these, there is the potential for long-term interference with public works projects at some sites that would require mitigative action. Two sites (Little Mystic Channel and Reserved Channel) have CSOs on site. Either the partial-fill or fastland scenario at the Little Mystic Channel site or the partial-fill scenario at Reserved Channel

would require rerouting of these CSOs. There is concern that the Spectacle Island site could disturb the integrity of the closure of the Spectacle Island landfill and subsequent park development. Additional site investigations would be necessary to evaluate the likelihood that disposal activities would avoid conflict activities on Spectacle Island.

Water quality modelling (Appendix F; and Section 4.2) indicates that disposal would not affect the proposed artificial reef. The Meisburger sites are proximal to the MWRA sewage outfall currently under construction. There is concern, on MWRA's part, that the proximity of these activities could make interpretation of outfall monitoring results extremely difficult given the coincidence of dredging disposal with the early stages of the new outfall operation. The Meisburger sites would be considered to have low practicability for this criteria.

Interference with fishing activities would cease at the completion of the disposal operations, although recovery of the resource would extend for a longer period. Each of the offshore sites, Meisburger 2, Meisburger 7 and Boston Lightship, were found to support large standing stocks of fishable resources. Meisburger 2 and 7 are both heavily fished for lobster. Lobstering activity is variable in Boston Harbor, but is more focussed in the Outer Harbor. The Chelsea River provides habitat for juvenile winter flounder. Because of the current status of the fisheries resources and the fishing industry in New England, sites that would experience this type of conflict are also considered to have low practicability for the BHNIP unless mitigative actions are readily available.

Disposal activities at sites that are located within designated navigation channels (Mystic River, Chelsea River, Inner Confluence and Subaqueous B) could interfere with navigation during the period while disposal occurred. Interference would cease when the disposal was completed. The degree of interference could be minimized by careful management of disposal activities and administration of navigational restrictions. Navigational conflicts were considered to rank these sites as having moderate practicability.

The remaining sites, Amstar, Cabot Paint, Mystic Piers, Revere Sugar and Subaqueous E would conflict with other uses. Therefore, they are rated as having high practicability for dredged material disposal.

In terms of conflicts with other activities, the potential aquatic disposal sites would be ranked from high to low practicability:

- Amstar, Cabot Paint, Mystic Piers, Revere Sugar, Subaqueous E
- In-channel (Mystic River, Inner Confluence), Subaqueous B
- Little Mystic Channel, Reserved Channel, In-channel (Chelsea River), Spectacle Island, Meisburger 2, Meisburger 7, Boston Lightship

4.3.7 Capacity

Site capacity is an easy factor to quantify. However, direct comparison across sites, especially between upland and aquatic is not simple because many of the sites examined for the BHNIP could provide only a portion of the needed capacity. In the most simple terms, those sites that could provide the capacity needed for the entire volume of silt that would be dredged

during the BHNIP would have the highest practicability. Those sites that could provide at least 30% (about 400,000 cy) of the needed capacity would have moderate practicability for the BHNIP. Those sites that could provide less than 30% of the needed capacity for the BHNIP would have low practicability. The short-listed sites fit these categories as follows:

- High - In-channel sites combined, Spectacle Island, Meisburger 2, Meisburger 7, Boston Lightship
- Moderate - Wrentham, Little Mystic Channel (fastland), Subaqueous B, Subaqueous E
- Low - Woburn, Squantum Point, Everett, lined landfills, fast-land shoreline sites (Amstar, Cabot Paint, Mystic Piers, Revere Sugar), partial-fill shoreline sites (Amstar,Cabot Paint, Little Mystic Channel, Mystic Piers, Reserved Channel, Revere Sugar)

The DEIR/S identified possible combinations of sites that could provide the required capacity for the BHNIP. These combinations are described in Section 3. Commenters on the DEIR/S favored combination options to achieve the capacity needs including A1 (all landfills); B1 (all aquatic shoreline sites); B5 (various combinations of aquatic sites); and C1-C4 (combinations of upland and aquatic sites).

It was determined in the DEIR/S that the landfills (Option A1) were incapable of accepting the total quantity of silt for disposal. Further investigations for the FEIR/S found that the silt from the BHNIP would require dewatering and may be unsuitable for daily cover and contouring at these landfills. Therefore, the landfill capacity continues to be inadequate for the BHNIP. Additionally, several of the comments received on the DEIR/S indicated a reluctance to see permitted landfills in the state used for large scale dredge material disposal. Smaller scale projects may be more suited to landfill disposal.

In the B1 combinations, it would take a minimum of four shoreline sites to accommodate the entire volume of silt generated by the BHNIP. A possible combination would include filling Little Mystic Channel, Amstar, and Revere Sugar to fastland (totalling 1,285,000 cy) and partially filling (35,000 cy) Mystic Piers. This would result in the loss of habitat at these locations without the benefit of readily available compensatory mitigation.

Option B5 could be developed in many ways. Use of two of the federal channels for disposal could be supplemented with a shoreline site (most likely Little Mystic Channel). Costs for this scenario could be minimized by distributing the disposal in the most cost-effective way. However, this would still be a more expensive alternative than some of the others. Combining two in-channel locations with either a subaqueous site or a borrow pit site would be less expensive than including a shoreline site because of the reduced infrastructure. Subaqueous E could be combined with the fastland scenario at Little Mystic Channel to attain the necessary volume. In this case, there would be some excess capacity. It might be appropriate to leave this at Little Mystic Channel for use in future use. The two subaqueous sites could be combined with a smaller shoreline site such as Mystic Piers (fastland) or Reserved Channel (partial

fill). Either of these options would use virtually the full capacity of the three sites. A final combination could include the two subaqueous sites and a portion of one of the borrow pits. In this option, reserving excess capacity at the borrow pit sites could enable their use in the future.

The DEIR/S "C" options include combinations of land-based and aquatic sites. Because of constraints associated with dewatering, it has been assumed that only 200,000 cy could be designated for upland disposal from the BHNIP. Either Squantum Point or Wrentham could provide 200,000 cy or greater capacity.

The small capacity of Everett (37,000 cy) precludes practicable use of this site in the BHNIP. Its prime location may make it suitable for future, smaller projects, however, use of Squantum Point or Woburn in conjunction with a single, moderately sized aquatic site for the remainder of the silts would accommodate the BHNIP. Use of Wrentham for part of the BHNIP silts would leave a portion of that site (approximately 250,000 cy) available for future dredging projects.

Also, capacity alone is not a deciding factor in practicability analysis. As described in previous subsections, these are logistical, engineering, and permittability issues which complicate the capacity discussion.

The capacity of the various sites for projects other than the BHNIP cannot be fully projected here. Generally, it would be expected that a project proponent would attempt to identify a single site that would have sufficient capacity for the dredged material that could not be disposed in a designated disposal area.

4.3.8 Cost

A general comparison of the cost of using individual disposal sites can be made on a unit price (cost per cubic yard) basis. The costs listed on Tables in Chapter Three reflect use of the full capacity of each site except the Meisburger 2 and 7 and the Boston Lightship sites where costs are not linked directly to volume. Based strictly on unit cost, the sites would be ranked from highest to lowest practicability as follows:

- High - Boston Lightship ($16); Subaqueous B, Subaqueous E, Spectacle Island ($20);
- Moderate - In-channel (Mystic River, Chelsea River, Inner Confluence) ($30), Meisburger 2, Meisburger 7, Little Mystic Channel (fastland), Mystic Piers (fastland) ($30-39); Little Mystic Channel (partial-fill), Mystic Piers (partial fill), Amstar (fast-land), Squantum Point ($40-51);
- Low - Amstar (partial fill), Reserved Channel (partial fill), Revere Sugar (fast-land), Cabot Paint (fastland), East Bridgewater, Wrentham, Woburn, Everett ($60-80); Revere Sugar (partial fill), Plainville, Fitchburg/Westminster (> $90); Cabot Paint (partial fill) ($360)

4.3.9 Future Use

This issue is linked to capacity and permitability because it addresses the questions of whether a particular site could experience repeated use and whether the site would be available if it is not used for the BHNIP. Ranking the disposal sites for future use has no direct meaning for this

current project. This is provided in accodance with the MEPA directive to consider future needs and provide a consideration of options.

4.3.9.1 Upland Sites

All of the upland sites may be more feasible for future use than for the BHNIP, due primarily to the potentially lengthy permitting process required for siting an upland lined disposal facility. The proximity of Everett and Squantum Point to Boston Harbor make these sites especially attractive for dredge disposal. Even other ports may find these more accessible than overland transport. The small size of Everett may preclude its feasibility for anything but a local small project. However costs and other design factors may eliminate upland monofills as reasonable options for smaller dredge projects. Again, dewatering, hauling and other related issues remain.

An advantage offered by upland sites over aquatic sites is the ease of construction of cells for repeated use by several dredge projects. The large size of Wrentham makes it especially attractive as a multiple use site, however costs of dewatering and construction may keep upland sites as impracticable.

4.3.9.2 Aquatic Sites

The in-channel sites are unique in that they would be available only when the channels are dredged, either for improvement or maintenance dredging. These sites would not be available for future dredging projects that are not directly linked to channel dredging. Several options were discussed in Section 4.3.7 that consider using a portion of the available in-channel capacity. If once of these options was identified as the least environmentally damaging practicable alternative (LEDPA), the remaining tributary could be available for future channel maintenance operations.

For the partial-fill shoreline alternatives, two factors combine to make multiple use of these sites impracticable. The construction costs are relatively high and would have to be incurred by the first user. In addition, interim closure of these sites (capping and cutting off of the bulkhead to restore tidal flow) would make reuse of the site logistically difficult.

One BHNIP combination option, involving Little Mystic Channel and Subaqueous E, could yield an excess capacity of about 111,000 cy. Underfilling Little Mystic Channel initially could allow limited future use, probably on a one-time basis. Without considering complex combinations of numerous sites, no other shoreline site would have the potential for repeated use.

The Subaqueous sites (B and E) would be suitable for a one-time use only. The dimensions of the perimeter dike and the cap needed to contain silt at these sites represent a significant portion of the total site footprint. Development in cells would result in further reductions in site capacity. This would preclude multiple uses of these sites.

While the geological conditions at the Spectacle Island CAD site suggest that it could not be developed in cells for the total BHNIP volume, it would likely be possible to construct cells of smaller volume without compromising the site's structural integrity. Thus two options that were described in Section 4.3.7 in which the Spectacle Island (as a representative

borrow pit) site was combined either with the two Subaqueous sites or a combination of in-channel sites, could result in excess capacity at Spectacle Island that would be usable in the future.

The Meisburger sites each have the potential to provide capacity far in excess of the BHNIP needs. Because these sites would be developed as relatively shallow borrow pits over large footprints, there is limited concern for structural integrity between cells. If either of these sites was used for the BHNIP, it is highly likely that there would be interest in using them again in the future. The large capacity available would generate interest in repeated use. As stated in Section 4.3.2, however, use of either site would probably require a formal site designation study.

There are no known physical limitations to the capacity of the Boston Lightship site. As with the Meisburger sites, use for the BHNIP would not preclude future use and would likely encourage it, triggering the need for a formal site designation study. Again, even if this site is not used for the BHNIP, there may be further interest in using it for other projects. It would be a candidate for repeated uses.

4.5 IDENTIFICATION OF THE PREFERRED ALTERNATIVE FOR THE BOSTON HARBOR NAVIGATION IMPROVEMENT AND BERTH DREDGING PROJECT (BHNIP)

Selection of the preferred alternative must consider both environmental impacts (as addressed in Sections 4.2 and 4.3) and practicability (as addressed in Section 4.4) of the alternatives under review. Both NEPA and MEPA emphasize the concept of selecting the least environmentally damaging alternative (LEDA) that is practicable for the project proponent to construct. Thus, the sites that were identified as having the lowest levels of environmental impacts for the BHNIP disposal were examined for practicability.

The sites that would incur the lowest level of environmental impacts were identified in Sections 4.2 and 4.3. The LEDA sites are:

A. Land-based:
- lined landfills
- Everett
- Squantum Point
- Woburn
- Wrentham

B. Aquatic:
- Amstar (partial fill)
- Cabot Paint (partial fill)
- Little Mystic Channel (partial fill)
- Mystic Piers (partial fill)
- Reserved Channel (partial fill)
- Revere Sugar (partial fill)
- Mystic River in-channel
- Chelsea River in-channel
- Inner Confluence in-channel

These sites were reviewed in terms of cost and capacity (Table 4-7), as a first step in assessing their practicability. This review concluded that most of the LEDA sites were less desirable for the BHNIP because of high cost or low capacity. The surviving sites are Squantum Point, Little Mystic Channel (partial fill), Mystic River (in-channel), Chelsea River (in-channel) and Inner Confluence (in-channel).

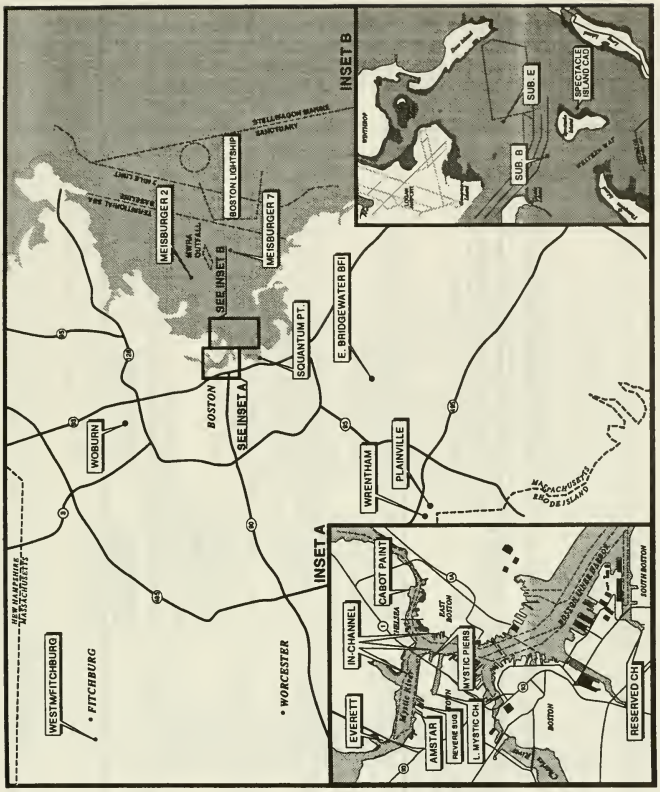
In order to distinguish among these sites, the environmental impacts and practicability issues were reexamined. Squantum Point was eliminated at this stage because of intertidal dredging and

wildlife habitat impacts (Table 4-2) and its low practicability for availability, permitting, ease of engineering and logistics (Table 4-7). Of the remaining four sites, use of Little Mystic Channel would result in filling outside the footprint of the dredging project and a permanent alteration in depth from subtidal to intertidal, both of which were viewed as more substantial environmental impacts. In addition, Little Mystic Channel was lower in practicability for most issues (availability, permittability, ease of engineering, and logistics; Table 4-7) than the in-channel sites.

The preferred alternative for the disposal of silts from the BHNIP is, therefore, in-channel disposal in the Mystic River, Chelsea River and Inner Confluence, within the footprint of the dredging project. Distinct advantages of using this alternative include confining disposal impacts to the areas impacted by dredging activities, anticipated rapid recovery of biological resources to preexisting status, ability to sequester dredged silts near their point of origin, and ability to compartmentalize the disposal operation.

4.6 FUTURE MAINTENANCE

The selection of the disposal site for future maintenance dredging must reexamine the environmental and practicability criteria discussed above. Factors such as sediment characteristics and volume of the dredging project will be critical in determining the suitability of the disposal sites. Sites such as Little Mystic Channel and Squantum Point would receive high priority in this review. Sites that were identified in this review as having lengthy permitting needs, but were otherwise reasonable, would also be reviewed carefully. The disposal site for future maintenance will be determined based on the appropriate environmental regulations and technical evaluations at that time. The New England Division Corps recommends, and will participate with the Commonwealth in, conducting an overall regional dredged material management plan for future maintenance of all of Massachusetts Bay's harbors.



Boston Harbor Dredging Project EIR/S	Figure 4-1. Locations of short-listed sites.
N Scale: 0 10 Approx. Scale in Miles	Source: USGS Quadrangles Revised by NAI to reflect pertinent site conditions.

TABLE 4-1. SUMMARY OF IMPACTS TO BHNIP LAND-BASED ALTERNATIVE DISPOSAL SITES.

Site	Capacity (cy)	Permanent Losses	Temporary Losses	Permanent Alteration	Indirect Impacts
All Lined Landfills	200,000	None	None	None	Odor and noise would be part of landfill operation
Everett	37,000	Highly disturbed vegetation and wildlife habitat.	Channel dredging in subtidal; shorebird use; common tern use.	Same as losses.	Odor and noise.
Wrentham	315,000	Large tract of forest and shrubland.	Odor and noise along trucking route.	Same as losses.	Forest fragmentation; tax loss; odor and noise.
Woburn	158,600	1 acre of forested wetland. Highly disturbed vegetation and wildlife habitat.	Odor and noise along trucking route.	Same as losses.	Odor and noise.
Squantum Point	210,000	Moderately disturbed vegetation and wildlife habitat.	Channel dredging in subtidal; shorebird use.	Channel dredging in intertidal wetlands.	Freshwater runoff; park plans' odor and noise.

TABLE 4-2. COMPARISON OF THE SIZE AND EFFECT OF DIRECT IMPACTS AT BHNIP ALTERNATIVE AQUATIC DISPOSAL SITES.

SITE	DIRECT IMPACT IN EXCESS OF DREDGED AREA	EFFECT OF IMPACT	EXISTING BENTHIC PRODUCTIVITY VALUE	POTENTIAL RECOVERY RATE
SHORELINE: FILL TO FASTLAND				
Amstar	3.5 acres	**Permanent loss** of benthic productivity and feeding and refuge habitat.	**Low**	No Recovery
Cabot Paint	5.6 acres		**Low**	No Recovery
Little Mystic Channel	15.0 acres		**Low**	No Recovery
Mystic Piers	2.7 acres		**Low**	No Recovery
Revere Sugar	3.7 acres		**Low**	No Recovery
SHORELINE: PARTIAL FILL				
Amstar	3.5 acres	**Temporary loss** of benthic productivity and feeding and refuge habitat. **Positive effects:** existing contaminated sediments capped; increased productivity in Reserved Channel. Permanent alteration in depth (subtidal to intertidal) and substrate.	**Low**	**Rapid**
Cabot Paint	5.6 acres		**Low**	**Rapid**
Little Mystic Channel	15.0 acres		**Low**	**Rapid**
Mystic Piers	2.7 acres		**Low**	**Rapid**
Reserved Channel	7.7-16.6 acres		**Low**	**Rapid**
Revere Sugar	3.7 acres			**Rapid**
IN-CHANNEL				
Mystic River	0 acres*	**Temporary loss** of benthic productivity concurrent with and in same footprint as improvement dredging of existing channels.	**Low**	**Rapid**
Chelsea River	0 acres*		**Low**	**Rapid**
Inner Confluence	0 acres*		**Low**	**Rapid**
SUBAQUEOUS DEPRESSIONS				
Subaqueous B	83 acres	**Temporary loss** of benthic productivity and feeding and refuge habitat. Permanent alteration of depth and substrate character. Permanent loss of cooler water refuge habitat.	High	Moderate
Subaqueous E	79 acres		High	Moderate
BORROW PITS				
Spectacle Island	45 acres +	**Temporary loss** of benthic productivity within pit; undefined area for cap storage would experience temporary loss of benthic productivity; cap may require armoring leading to permanent change in substrate character and benthic community.	High	Moderate
Meisburger 2	86 acres +		Moderate-High	Slow
Meisburger 7	121 acres +		Moderate-High	Slow
DISPOSAL SITES				
Boston Lightship	100 acres (est.)	**Temporary loss** of benthic productivity; permanent change of depth and substrate character.	Moderate-High	Slow

*The entire disposal footprint (about 56 acres in the Mystic River, 40 acres in the Chelsea River and 21 acres in the Inner Confluence) would be within the boundaries of the channel improvement dredging.

TABLE 4-3. SUMMARY OF SHORT-TERM WATER QUALITY EFFECTS FROM DISPOSAL AT BHNIP ALTERNATIVE DISPOSAL SITES.

SITE	MIXING ZONE		EXCEEDANCES OF CHRONIC WATER QUALITY CRITERIA OR STANDARDS
	Size (acres)[a]	Parameter of Concern	
SHORELINE: FILL TO FASTLAND			
Amstar	N/A		N/A
Cabot Paint	N/A		N/A
Little Mystic Channel	N/A		N/A
Mystic Piers	N/A		N/A
Revere Sugar	N/A		N/A
	N/A		N/A
SHORELINE: PARTIAL FILL			
Amstar	N/A		N/A
Cabot Paint	N/A		N/A
Little Mystic Channel	N/A		N/A
Mystic Piers	N/A		N/A
Reserved Channel	N/A		N/A
Revere Sugar	N/A		N/A
IN-CHANNEL			
Mystic River	12.4	TSS	None anticipated
Chelsea River	30.0	TSS	None anticipated
Inner Confluence	14.7	TSS	None anticipated
SUBAQUEOUS DEPRESSIONS			
Subaqueous B	10.4	TSS	None anticipated
Subaqueous E	8.9	TSS	None anticipated
BORROW PITS			
Spectacle Island	7.7	TSS	None anticipated
Meisburger 2	9.6	TSS	None anticipated
Meisburger 7	9.6	TSS	None anticipated
DISPOSAL SITES			
Boston Lightship	10.0	TSS	None anticipated

[a]In-channel: smaller mixing zone represents typical project disposal schedule; larger mixing zone caused by anticipated period of higher-than-average disposal rate.

TABLE 4-4. POTENTIAL SOURCES OF SITE DESTABILIZATION THAT COULD ARISE DURING AND/OR AFTER CONSTRUCTION AT BHNIP ALTERNATIVE DISPOSAL SITES.

SITE	TIDAL CURRENTS		STORM & WIND EVENTS		VESSEL ACTIVITY		OTHER	
	During	After	During	After	During	After	During	After
SHORELINE: FILL TO FASTLAND								
Amstar								
Cabot Paint								
Little Mystic Channel								
Mystic Piers								
Revere Sugar								
SHORELINE: PARTIAL FILL								
Amstar						X		
Cabot Paint						X		
Little Mystic Channel						X	CSOs	CSOs
Mystic Piers						X		
Reserved Channel							CSOs	CSOs
Revere Sugar						X		
IN-CHANNEL								
Mystic River					X	X		
Chelsea River					X	X		
Inner Confluence					X	X		
SUBAQUEOUS DEPRESSIONS								
Subaqueous B	X	X	X	X	X	X		
Subaqueous E	X	X	X	X				
BORROW PITS								
Spectacle Island	X	X	X	X				
Meisburger 2			X	X				
Meisburger 7			X	X				
DISPOSAL SITES								
Boston Lightship			X	X				

TABLE 4-5. SUMMARY OF POTENTIAL IMPACTS TO DOWNSTREAM BIOLOGICAL AND HUMAN USE RESOURCES FROM BHNIP DISPOSAL SITE ALTERNATIVES.

SITE	BIOLOGICAL RESOURCES					HUMAN USE RESOURCES		
	Anadromous Fish	Winter Flounder	Lobster	Clams	Benthos	Fishing Grounds	Water Intake	Human Contact
SHORELINE: FILL TO FASTLAND								
Amstar	P	P	P		P		P	
Cabot Paint	P	P	P	P	P		P	
Little Mystic Channel	P	P	P		P		P	
Mystic Piers	P	P	P		P		P	
Revere Sugar	P	P	P		P		P	
SHORELINE: PARTIAL FILL								
Amstar	P	P	P		P		P	
Cabot Paint	P	P	P	P	P		P	
Little Mystic Channel	P	P	P		P		P	
Mystic Piers	P	P	P		P		P	
Reserved Channel		P	P		P			
Revere Sugar	P	P	P		P		P	
IN-CHANNEL								
Mystic River	P	D,P	P		D,P		P	
Chelsea River	P	D,P	P	P	D,P		P	
Inner Confluence	P	D,P	P		D,P		P	
SUBAQUEOUS DEPRESSIONS								
Subaqueous B		D,P	D,P		D,P	D,P		P
Subaqueous E		D,P	D,P	P	D,P	D,P		
BORROW PITS								
Spectacle Island		D,P	D,P	P	D,P	P		P
Meisburger 2		D,P	D,P		D,P	D,P		
Meisburger 7		D,P	D,P		D,P	D,P		
DISPOSAL SITES								
Boston Lightship		D,P	D,P		D,P	D,P		

D = during disposal
P = post-construction cap failure

TABLE 4-6. SUMMARY OF RELATIVE SEVERITY OF IMPACTS[a] OF POTENTIAL BHNIP AQUATIC DISPOSAL ALTERNATIVES.

	SITE STABILITY		DOWNSTREAM IMPACTS		
DIRECT IMPACTS	CONSTRUCTION	POST-CONSTRUCTION	CONSTRUCTION	POST-CONSTRUCTION	BIOLOGICAL EXPOSURE
• **In-channel**	• **Shoreline-partial**, fastland	• **In-channel**, shoreline-fastland	• **In-channel, shoreline-partial**, fastland	• **In-channel, shoreline-partial**, fastland	• **In-channel, shoreline-partial**
• **Shoreline-partial**	• **In-channel**	• Meis 2, Meis 7	• Spec Is, Sub B, Sub E, Meis 2, Meis 7, BLS	• Meis 2, Meis 7, BLS	• Meis 2, Meis 7, shoreline-fastland
• Spec Is, Meis 2, Meis 7, BLS	• Meis 2, Meis 7	• **Shoreline-partial**		• Sub B	
• Sub B, Sub E	• BLS	• Sub E		• Sub E, Spec Is	• Spec Is
• Shoreline-fastland	• Sub E	• Sub B			• Sub B, Sub E
	• Sub B, Spec Is	• Spec Is, BLS			• BLS

[a]Listed in order of least to greatest effect within each impact.

TABLE 4-7. SUMMARY OF FACTORS AFFECTING PRACTICABILITY OF ALTERNATIVE DISPOSAL SITES.

	Availability	Permitting	Ease of Engineering	Logistics	Ease of Monitoring	Compatibility with other Activities	Capacity [cy]	Cost
UPLAND SITES								
Lined Landfills	HIGH[1] [No purchase required]	MODERATE [Dewatering]	LOW [Dewatering facility]	LOW [Dewatering; Multiple handling; hauling distance]	HIGH [Dewatering only]	HIGH [No conflicts]	LOW	LOW
East Bridgewater	"	"	"	[1 hour trucking]	"	"	[200,000 cy]	$62
Plainville	"	"	"	[2 hours trucking]	"	"	[200,000 cy]	$94
Fitchburg/Westminister	"	"	"	[3 hours trucking]	"	"	[200,000 cy]	$108
Coastal Sites	LOW	LOW [Solid Waste siting; dewatering]	LOW [Monofill facility; dewatering facility]	LOW [Haul by barge; dewatering; double handling]	MODERATE [Groundwater; air quality; leachate; dewatering]			
Squantum Point	[Municipally owned]	"	"	"	"	MODERATE [MDC park plans]	MODERATE21 0,000 cy	MODERATE $51
Everett	[Privately owned]	"	"	"	[Complicated by adjacent 21-E]	HIGH [No conflicts]	LOW 37,000 cy	LOW $76
Inland Sites	LOW	LOW [Solid Waste siting; dewatering]	LOW [Dewatering; multiple handling; haul by truck]	LOW [Dewatering; multiple handling; haul by truck]		HIGH (No Conflicts)		LOW
Woburn	[Municipally owned]	"	[Former landfill]	"	[Complicated by existing closed landfill]	"	LOW 158,600 cy	$69
Wrentham	[Privately owned]	"	LOW	"	MODERATE	"	MODERATE 451,200	$62

	Availability	Permitting	Ease of Engineering	Logistics	Ease of Monitoring	Compatibility with other Activities	Capacity [cy]	Cost
AQUATIC								
Shoreline-Fastland	MODERATE	MODERATE [Aquatic habitat loss]	MODERATE [Bulkhead with drainage]	MODERATE [Double handling likely; close to dredge site]	MODERATE [Engineered structure]	HIGH	LOW	LOW
Amstar	Designated Port Area	"	"	"	"	[None]	241,000	$50
Cabot Paint	Designated Port Area	"	"	"	"	"	198,000	$65
Little Mystic Channel	LOW State Waters	"	"	"	"	LOW [CSOs]	MODERATE 840,000	MODERATE $47
Mystic Piers	MODERATE Designated Port Area	"	"	"	"	HIGH [None]	LOW 187,000	$38
Revere Sugar	"	"	"	"	"	"	204,000	LOW $61
Shoreline-Partial Fill								
Amstar	"	HIGH [No designation required]	MODERATE [Bulkhead, cap, partial removal of bulkhead]	MODERATE [Double handling likely; close to dredge site]	MODERATE [Engineered structure, resource recovery rapid]	HIGH	LOW 128,000	LOW $62
Cabot Paint	"	"	"	"	"	"	18,000	$362
Little Mystic Channel	LOW State waters	"	"	"	"	LOW [CSOs]	373,000	MODERATE $47

	Availability	Permitting	Ease of Engineering	Logistics	Ease of Monitoring	Compatibility with other Activities	Capacity [cy]	Cost
Mystic Piers	MODERATE Designated Port Area	HIGH No designation required	MODERATE	MODERATE	MODERATE	HIGH [None]	98,000	$47
Revere Sugar	MODERATE Designated Port Area	" No designation required	"	"	"	HIGH [None]	86,000	LOW $93
Reserved Channel	LOW State Waters	"	"	"	"	LOW [CSOs]	186,000	$45
<u>In-Channel</u>	MODERATE	HIGH	HIGH	HIGH	MODERATE	MODERATE	HIGH	MODERATE
Mystic River	Federal Channel, DPA	"	Dredge cells, sand cap	Close to dredging, little need to stockpile, single handling	"		742,100	30
Chelsea River	"	"	"	"	"	LOW [Navigating fish]	332,400	30
Inner Confluence	"	"	"	"	"	MODERATE [Navigation]	245,900	30
<u>Subaqueous Depressions</u>	LOW	LOW (Designation required)	HIGH	MODERATE [Delay until dike material available, near dredge site but requires traversing entire ship channel]	MODERATE [Cap integrity, resource recovery [intermediate]	MODERATE	MODERATE	LOW
Subaqueous B	LOW State Waters	"	Dike [clay] + cap				562,000	$20
Subaqueous E	LOW	LOW	HIGH	MODERATE	MODERATE	MODERATE	MODERATE 591,000	LOW $19

	Availability	Permitting	Ease of Engineering	Logistics	Ease of Monitoring	Compatibility with other Activities	Capacity [cy]	Cost
Borrow Pits	LOW	LOW	HIGH	MODERATE [Barging through entire harbor minimal delay for site prep.]	MODERATE	MODERATE Cap integrity, resource recovery, [intermediate]	HIGH	MODERATE
Spectacle Island	State Waters	No designation required	Dredge pit, self cap	"		"	1,320,000	$21
Meisburger 2	State Waters	LOW Disposal Site Designation Study	MODERATE Dredge cells [but marginal at this depth], self cap	"	LOW Cap integrity, resource recovery, [prolonged]	"	1,320,000+	$30
Meisburger 7	State Waters	"	"	"	"	"	1,320,000+	$33
Disposal Sites	HIGH	LOW	MODERATE	MODERATE	LOW	MODERATE	HIGH	
Boston Lightship	Federal Waters	(Site Designation Needed)	No site preparation; capping unconfirmed	Most distant aquatic site but distance would not constrain production rate			Unlimited (1,320,000+)	LOW $16

[1]HIGH = highly practicable for the specific criterion
MODERATE = moderately practicable for the specific criterion
LOW = low practicability for the specific criterion

Chapter Five: Dredging Management Plan

The Dredging Management Plan, described in this section, provides an overview of the dredging operation proposed for the improvement of Boston Harbor and related berth facilities. The key elements of the Plan include: a description of alternative dredging equipment and specific recommendations for this project; dredged material disposal operations; sequencing of the dredging and disposal operations; an overview of potential environmental impacts caused by dredging and proposed techniques and equipment to mitigate these impacts; establishment of dredging performance standards; a description of recommended monitoring plans during dredging and for long term post-construction monitoring; and a discussion of operational contingency plans which would be implemented to assure the safe and successful completion of the project. The Plan focuses upon those details of dredging and related operations as they may impact the environment.

5.1 SELECTION OF DREDGING METHOD

A broad range of dredging equipment types and operating techniques are available for the dredging of sediments and rock from Boston Harbor. Identification of the best dredging method for the BHNIP requires the consideration of the factors described in the following paragraphs.

5.1.1 Project Objectives

Approximately 2.8 million cubic yards of in-situ material will be removed as part of the BHNIP. This total volume includes an estimated 1.1 million cubic yards of contaminated silt, 1.6 million cubic yards of parent material, and 88,000 cubic yards of rock. As described in Chapter 2.0, an additional 1.8 million cy of parent material will be dredged to provide in-channel disposal volume for the silt.

Dredging and rock removal will take place in the existing authorized Federal channel and in berth facilities throughout the harbor area. The proposed project depth is -38 ft. (MLW) in the Chelsea River (known locally as Chelsea Creek) and -40 ft. (MLW) in sections of the Mystic River, Reserved Channel, and a portion of the Main Ship Channel. The maximum depth of dredging will typically be approximately -55 ft (MLW) with some areas reaching -70 ft. (MLW) to prepare the in-channel disposal facilities.

Boston Harbor is subject to a normal tidal range of approximately 9.5-ft. Peak tidal currents range from approximately 0.7-knots through the Inner Confluence to around 0.5-knots in both the Mystic River channel and the Chelsea Creek. The project site is subject to periodic northeast storms and seasonal hurricanes which can generate severe winds, waves, and extreme water surface elevations. Historic storm-related high water events, measured at the Commonwealth Pier, have exceeded 14 ft.

(MLW). Such storm events will challenge the operating limits of personnel and equipment.

Dredging operations will be performed such that all of the identified contaminated silts are efficiently removed. The equipment used must remove the maximum amount of sediments with minimum cross-contamination of silt and parent material. This will require the use of equipment which can consistently dredge to a depth tolerance of less than 0.5 feet.

Project objectives also require that the selected dredge equipment be capable of accomplishing the task within time allotted while assuring a safe and environmentally responsible project. Dredge and material transport downtime must be minimized to avoid costly additional disposal. Over-dredging (removing more material than required) must be minimized. The dredging and support equipment must be able to efficiently reach each dredging site, for example, upstream of the Chelsea Street Bridge.

5.1.2 Physical Limitations

The project site is an active harbor with extensive commercial vessel traffic. About two deep draft commercial vessels per day transit the channel reaches, both entering and leaving the harbor. These vessels typically maintain minimum bottom clearances when transiting fully loaded. Water velocities, generated by the propeller wash of transiting vessels of this kind, and by that of assisting tugs, can be of sufficient magnitude to resuspend unconsolidated bottom sediments. Studies have shown the resuspended solids may move 300 - 400 feet during these events. It is anticipated that granular material will move much less and that in areas such as the Inner Confluence where there are the highest instances of propeller wash material to be blasted during the project may be used. Dredging operations will be performed at exposed open water locations as well as at confined nearshore berthing facilities. Floating equipment must minimally impact normal commercial vessel operations (being easily moved when required). Dredging equipment will be adequately sized to operate within confined berths.

Channel deepening, particularly within limited reaches of the Mystic River and Chelsea Creek, could affect the stability of bulkheads and pile supported structures situated along the edge of the channel section. Preliminary studies have indicated no stability concerns but the contractor will be directed to make his "box cut" (vertical sides) well inside the channel limits. In addition, the project site is characterized by numerous utility crossings. These facilities will be identified and protected during the dredging and rock removal operations. Dredging operations will be performed in the vicinity of commercial and residential structures. Construction noise is not anticipated to be a major problem.

5.1.3 Turbidity

There are three primary causes for turbidity levels to exceed those of background during the proposed dredging and material disposal operations:

Turbidity generated by dredging operations is typically due to: (1) the impact and subsequent removal of the bucket from the bottom; (2) spilling fine sediments from the bucket as it is hauled through and out of the water column; and (3) from disposal and capping operations when the dredged materials are dumped from the transport scows into the disposal site.

Turbidity generated by the dredging operation can be minimized by the careful control of the rate of dredging. Minimizing the swing speed and cutter rotation speed of a hydraulic dredge will generate minimum resuspension of bottom materials. Mechanical dredges will be fitted with closed environmental buckets which minimize the quantity of material which is lost from the bucket as it is hauled through the water column. Slower bucket cycling rates will reduce the turbidity generated by mechanical operations. Use of sensors to confirm full bucket closure is also anticipated.

5.1.4 Trash and Debris Management

Dredging operations may encounter a variety of trash and debris especially in the berth areas. Removal of these materials will typically be performed by the on-site dredge. Small items such as rotted timber, miscellaneous wire rope, cables, crushed drums and barrels, and items typically smaller than the excavating bucket will be removed with the bottom sediments and placed into the dump scow. These materials will be placed at the designated disposal sites as part of the normal disposal operation. Larger materials, and any items which may demonstrate a potential health or safety issue, will be specially handled. Large timber piles, vessel hulks, discarded vehicles, unidentified drums, and similar materials will be segregated from the bottom sediments for eventual disposal at upland sites.

Floating debris, resulting from the dredging or debris removal operations, will be skimmed from the water surface and placed into containers on the dredge or support barge. The dredging contractor will be required to develop and administer a Corps approved *Debris Management Plan*. This plan will require that the designated landfill facility be approved and that all load manifests be submitted to the Corps Contracting Officer. Contingency plans will be developed for managing any excavated containers with unknown contents or identified hazardous materials.

5.1.5 Compatibility with Disposal

Contaminated silts, dredged from the project areas, will be placed at designated in-channel facilities. Suitable granular parent material if available or imported sand material will be used for in-channel capping of the silts. Parent material not suitable for capping will be disposed of at Massachusetts Bay Disposal Site (MBDS) and/or transported to marine facilities for off-loading by others to stockpiles for use such as daily cover for landfills, construction fill, or other beneficial uses. Presently, there has been no indication of possible quantities to be used at landfills. Excavated rock will be processed and used as a thin armoring layer (6 - 12") over the in-channel disposal facility sand cap where

required due to high bottom velocities generated by propeller wash. Any surplus unprocessed rock will be transported to MBDS and/or to marine facilities for stockpiling and additional beneficial use. The transport distances for the parent material and rock will vary between several hundred yards to about 30 miles, depending upon the location of the disposal or off-loading sites.

Mechanical dredging will remove the bottom sediments with minimal change to the material water content. Transport of the mechanically dredged materials by bottom dump scows, and possibly barges for rock, will minimize the volume of water and material to be transported. Hydraulic dredging operations which would require the management and possible treatment of large volumes of water which would be transported through floating pipelines with the dredged materials. Rock would not typically be transported by hydraulic pipelines. Scow transport of the dredged material can accommodate the varying haul distances which are anticipated for the project.

5.1.6 Dredge Types

The proposed dredging will be performed only by proven equipment, utilizing demonstrated techniques. Three basic types of dredges are readily available. The following paragraphs briefly describe each.

5.1.6.1 Mechanical Dredge

Mechanical dredging uses equipment such as clamshell dredges, dipper dredges, draglines, grab buckets, as well as barge mounted excavators for the removal of bottom sediments and other materials. The dredged material removed by mechanical methods is typically high in solids content. Removal of the mechanically dredged material from the dredge site requires placement of the material in scows or on barges and transportation to the disposal area. The dredged material must be dumped, slurried, or mechanically re-handled for placement into the disposal facility. The mechanical dredge can leave an irregular bottom and typically generates relatively high levels of turbidity throughout the water column unless special closed "environmental" buckets are used and/or silt barriers are installed.

Mechanical dredges are rugged and highly reliable and capable of removing a broad range of materials, including unconsolidated silts, consolidated clays, sand, gravel, trash, and debris. Such equipment is able to operate in the open channel as well as within confined berth spaces. Barge or scow transport of the dredged material is efficient over long haul distances. Mechanical dredging productivity is generally low, when compared to hydraulic dredging operations, due to the depth of excavation and to scow loading operations. Such operations are subject to spillage and splashing, which allows sediments to resuspend in the water. Recent innovations in dredge bucket design have improved the ability to minimize turbidity caused by mechanical dredging operations.

5.1.6.2 Hydraulic Dredge

Hydraulic dredges operate using a solids handling centrifugal pump to transport dredged sediments through a pipeline. The dredged materials are hydraulically transported as a slurry from the dredge to a disposal site. The slurry can also be placed in barges for removal to the disposal site. The simplest form of hydraulic dredge, the plain suction dredge, removes unconsolidated bottom sediments through a tube which extends from the suction intake of a barge mounted pump to the channel bottom. The dredged slurry is pumped via pipeline to a stockpile or disposal site. The most significant improvement to the plain suction dredge is the addition of a mechanical cutterhead on the intake side of the suction tube. On the cutter-suction dredge, the suction head is fitted with a rotating open basket which includes blades or cutting teeth to remove the bottom materials and facilitate intake into the suction tube. As the cutter rotates and mechanically removes sediments from the bottom, a high velocity water flow captures the sediments and carries them as a slurry into the dredge suction. The cutter-suction dredge is versatile and highly efficient, and is available in a broad range of sizes to meet the demands of various size projects.

The hydraulic dredge is typically moved into position by a tug or push boat and stabilized by a spud system. The dredge typically uses three spuds or legs which pass through the deck barge and can be raised and lowered to the channel bottom to firmly hold the horizontal position of the dredge. The dredging operation consists of a lateral swing, controlled by anchor cables, of the cutterhead as the dredge barge pivots on a single spud. As the cutterhead swings from side to side, bottom material is excavated and pumped by the dredge. The dredge advances through the dredging reach by lowering a second stern spud following completion of a lateral swing. The first spud is raised, and the dredge is pivoted on the lowered spud in a walking fashion.

Bottom materials, excavated by the cutterhead and entrained by the suction intake, are pumped through a hydraulic pipeline from the dredge to a disposal site. Hydraulic dredges are able to excavate a broad range of materials. Turbidity, generated by the cutterhead, is typically limited to the immediate vicinity of the bottom intake. Turbidity is managed by controlling the cutterhead rotation speed, the swing speed of the dredge, and by implementing operational controls. Hydraulic dredges require the use of a floating or partially submerged pipeline which can obstruct navigation and restrict channel use. Hydraulic pipelines typically require in-line booster pumps to extend pumping distances and are thus restricted by practical and economic constraints. Hydraulic pipeline transport of dredged materials requires the use and entrainment of large volumes of water, typically between 3 and 5 times the in-situ dredging volume. Management of this water typically requires extensive facilities for processing when dealing with contaminated sediments.

5.1.6.3 Hopper Dredge

Hopper dredges are self propelled floating ships which include an integral suction pipe or several suction pipes which are dragged along the channel bottom. The bottom materials are drawn through a suction head on the drag arms and passed through the suction pipe and centrifugal pump and deposited, as a slurry, in a large onboard hopper. After loading, the hopper dredge can sail to an offshore or other designated dump site and open bottom doors and discharge the dredged materials. Some hopper dredges have the capacity to off-load the dredged materials by pumping. Hopper dredges are able to operate in sea conditions which would severely restrict the safe operation of other types of dredges. In addition, hopper dredges present a minimum interference to other vessel operations when working in busy channels and are able to efficiently transport dredged materials over short haul distances. However, disposal of the dredged materials requires that the dredging process be temporarily suspended as the dredge travels to the disposal site.

Hopper dredges are typically more effective when dredging in deep channel projects and are not effective in restricted areas such as berths and docking facilities. Hopper dredges have high production characteristics when dredging loose alluvial soils and unconsolidated sands, but are severely restricted by stiff clays and similar bottom materials. Very fine silts are easily dredged by hopper vessels, but such materials do not readily settle in the onboard hoppers. This requires the dredge to carry only partial loads, with relatively high water content, to the disposal site.

5.1.7 Rock Excavation Equipment

The BHNIP will include the removal of about 88,000 cubic yards of rock from various locations throughout the project. Specialized equipment, in addition to that required for the dredging activities, will be required for rock removal. Removal of unweathered rock from those areas which require increased depths will require pre-treatment prior to removal. This will include drilling and blasting of the rock formations. After removal of the silt and parent material overburden by dredging, the rock will be drilled. Removal of the overburden will allow the blasted rock to expand and fracture. This will make excavation more efficient.

Drilling is typically performed by a series of barge mounted drilling rigs, which will bore holes of pre-determined diameter and depth and in a specific pattern in the rock formation. The drilling barge is moved by an assisting tug or push boat and held in position by an anchoring system. An ancillary barge will likely be used to carry and store explosive materials. The drilled holes will be packed with precise quantities of explosive, which will be detonated in order to fracture the rock and facilitate removal.

The fractured rock, broken into manageable size pieces by the blast, will be removed by traditional mechanical dredge equipment using special rock handling buckets. The dredged rock will be handled in the following three ways: (1)

loaded into scows or on to barges for transport to either MBDS, or; (2) used as armoring layer over the cap for in channel disposal, or; (3) transported to marine facilities for off-loading to an upland site if the contractor presents a plan to the Corps for approval of the upland site.

5.1.8 Recommended Dredging Equipment and Performance Criteria

The selection of dredging equipment required factoring in all of the above considerations to be certain equipment will be capable of performing as required. In addition, the dredging operation will be continuously monitored to assure that specific minimum performance criteria are met which also affect the selection of dredging equipment. Those criteria will include, but not necessarily be limited to:

- Verification of dredging depth by periodic digital hydrographic soundings performed in accordance with Corps Class 1 standards, requiring accuracy to 0.5-ft.

- Verification of dredging location by periodic surveys performed in accordance with Corps Class 1 standards, which will require horizontal accuracy to within 3.0-m.

It will be the responsibility of the dredging contractor to assure that these criteria are satisfied. Independent verification of compliance with the critical operating criteria by the Corps Contracting Officer will assure that the project will proceed in a responsible manner. Results of these compliance reports will be made available to designated third parties, as appropriate.

5.1.8.1 Recommended Equipment

Dredging will be performed throughout the BHNIP site by barge mounted mechanical equipment. This equipment will provide continuous and reliable service for the entire duration of the project. The mechanical dredge can be fit with different types of buckets to optimize dredge production in the various materials which will be encountered. This dredge plant will be capable of operating in both the open channel sites as well as within the restricted berth areas. Dump scows will be used for hauling and placement of the dredged materials. Scows will also be used for temporary storage of silts during the initial phase of construction, while in-channel disposal facilities are under construction.

Hydraulic or hopper dredging operations are not recommended for the BHNIP for a number of reasons. The hydraulic dredge was not the preferred alternative because it would require a long pipeline system which would be a potential obstruction to navigation. There is no readily available area for construction of a facility to dewater the silt material and manage the high volumes of entrained water. Hopper dredging operations are not recommended because of the restricted operating areas and the anticipated difficulty of dredging the consolidated parent material. However, the Corps will entertain a contractor's suggestions for limited use of either hydraulic or hopper dredging equipment particularly in regard to in-

channel disposal where water entrainment would not be as great a concern.

Optimum production of the recommended mechanical dredge will require the use of as large a bucket as possible. Bucket size and type depend upon the available power on the dredge and the type of material to be excavated. Silts will be dredged using a sealed "environmental" bucket with a capacity of 15 - 22 cubic yards. The dredge crane will require between 1,500 and 2,000 horsepower. The "environmental" bucket has been successfully used to minimize turbidity in the immediate vicinity of dredge sites. The bucket is specifically designed to reduce sediment loss during closure, and rubber seals minimize the loss of fines as the bucket is drawn up through the water column. Parent material will be dredged using a heavier standard open bucket. The increased weight and digging teeth of a standard bucket will efficiently excavate these non-contaminated consolidated sediments with minimal loss of material through the water column.

Scows and barges will vary in size depending upon availability and location of the dredging operation. Dredged material scows typically range in size from 500 cy to 4,000 cy. It is anticipated that smaller scows will be used in the confined reaches of the project such as the berth areas. Larger scows will be used in the open channel reaches. The scows will be moved from the dredge sites to the disposal sites by tugs. Small harbor tugs, with on-board power of around 1,500 hp, would be used to transport the loaded scows to disposal sites within the channel area. Loaded scows, which transit exposed areas, will require the assistance of larger 3,000 hp ocean-going tugs.

The project volume is sufficiently large and the required work areas are so broadly spread out, that it is expected that the dredging Contractor will employ two (2) dredges. During the period when dredging is to take place in the Mystic River both dredges could work in different areas of the river and not interfere with each other. At other times, one dredge would work in the Reserved Channel and one dredge would work in Chelsea Creek.

Additional equipment which might typically be on site will include a fuel barge, a maintenance barge, and a small work tug to assist with moving the dredge and scows. Rock excavation will be initiated once the silt and parent material is removed and the rock is exposed. Special equipment associated with these operations is described in Section 5.2.4.

5.1.8.2 Operational Controls

The dredging operations, including the required drilling and blasting, can be managed sufficiently to minimize the associated environmental impacts. The principal objective of defining and implementing operational controls on the construction activities is to minimize sediment resuspension throughout the dredging process while maximizing operational efficiency. The drilling and blasting operations present an additional control challenge. Pressure wave propagation resulting from blasting can injure and kill fish. Specific blast control techniques must be incorporated into the

dredging program. The specific control methods which are employed will be dependent upon the dredging techniques which are implemented. Control techniques, demonstrated on other sensitive dredging operations, may include the following:

- Restricting the bucket drop velocity and haul speed during mechanical dredging.
- Employ a sealed "environmental" bucket as described in previous sections.
- Employ fish behavioral and control devices to reduce exposure to blasting areas.
- Contractually require that the dredging, disposal, and blasting operations meet specific minimum environmental performance standards and environmental windows.
- Include, as part of the contract documents, the requirement for submittal and implementation of project specific: *Accident Prevention and Site Emergency Plan; Environmental Protection and Turbidity Control Plan; Quality Control Plan;* and *Diving Plan.*
- Require the dredge operator(s) to meet specific minimum competency and experience requirements.
- Notify lobster fishing interests of dredge movements.

5.1.8.3 Contract and Specification Issues

Contract documents are used to clearly and equitably define the expectations and requirements of both the Corps' Contracting Officer and the Contractor for the successful completion of any construction project. A similar effort is expected between private berth owners and their contractors. The BHNIP contract documents will define the quantities, locations, and types of materials to be dredged. The required location and elevations of the dredged material, after it is placed at the in-channel disposal facilities, will be clearly defined. Proper location, materials, and acceptable tolerances for the disposal facility capping system will be clearly defined in the drawings and specifications for this project.

The project will be executed by the dredging contractor under the terms of a performance based contract. This means that the operation must satisfy specific performance standards during all operations. Dredging must be performed to the lines and grades defined on the design drawings and must be performed in such a manner as to control turbidity levels. If these criteria or standards are not achieved, the Contracting Officer will be obligated by contract to require the Contractor to alter the method of operation or cease operations until the required standards are met. The contract documents will clearly identify the procedures to be implemented by the

Contracting Officer in the event that the performance criteria are not met.

The Contracting Officer has the responsibility to enforce all terms of the contract and has the sole authority to direct the Contractor to alter or cease operations. It is anticipated that the Contracting Officer would secure the services of a qualified subcontractor to monitor the key performance criteria. It is likely that the dredging Contractor would simultaneously monitor those criteria to optimizing the operation and to demonstrate project quality assurance. Daily performance reports from the monitoring subcontractor will keep the Contracting Officer apprised of the operation performance. These reports would be available to interested parties.

5.2 DREDGING OPERATIONS

Orchestration of a large dredging project such as the BHNIP will require careful planning by a team made up of the US Army Corps of Engineers, Massport, State and Federal regulatory agencies, the dredging Contractor and critical Sub-Contractors, and public and commercial interests in and around Boston Harbor. The specific operations to be performed as part of the BHNIP are diverse, but all are directed at completing the project in an efficient and responsible manner. The following sections describe the specific operations.

5.2.1 Project Mobilization

Prior to the initiation of actual dredging, a number of preparatory tasks must be completed. The completion of these mobilization tasks will set the foundation for the efficient execution of the contract work.

5.2.1.1 Upland Support Requirements

Dredging and rock excavation operations will require an upland support area with direct access to the Harbor. It is anticipated that such a support facility can be provided at a Massport facility. It is possible that such sites could be used to support simultaneous activities in different parts of the Harbor. The upland support facility must provide sufficient vehicle parking for all of the project personnel. Temporary project trailers, including office facilities and enclosed material storage facilities will be placed at this site. Marine support equipment, such as personnel transports, survey vessels, tugs, and other craft will berth at this location. Repairs to both floating and support equipment will be performed at this staging area. These sites could also be used for temporary sediment dewatering facilities in the event that volume restrictions limit the quantity of material that can be placed at the in-channel disposal sites. However, neither of the dewatering sites would be large enough to handle the dewatering of all silt materials. Experience with dewatering of dredged material at Moran Terminal suggested use of thin lifts for air drying which would require acreages up to 80 acres.

5.2.1.2 Navigation and Commercial Traffic

Scows of various sizes will be used to transport the dredged materials from the dredging sites to the disposal facilities. Silts will be disposed at in-channel locations throughout the Inner Confluence, Mystic River, and Chelsea Creek. The silts will be capped with suitable parent material or sand which will be hauled within the Harbor in scows (see paragraph. 5.2.2.4). Excavated rock will be processed and placed from barges or scows on top of the sand cap as armoring to resist resuspension of the sand by the propeller wash of passing deep draft vessels. It is anticipated that two dredges will be simultaneously working in various sections of the Harbor during the project term. Modeling has shown that Federal water quality standards would not be violated. All commercial and recreational marine interests in Boston Harbor must be fully informed of the potential interference with normal traffic by the dredging equipment. Vessels will be required to navigate safely around the equipment. Larger commercial vessels will require special procedures to coordinate movement of the dredging equipment and securing of the disposal operations to allow passage through the channel.

Blasting operations will be performed in the Mystic River channel, the Inner Confluence, at the mouth of the Reserved Channel, and in the Main Channel east of the Reserved Channel. Vessel operators must be warned of all blasting operations. Blasting schedules will be provided to all commercial operators. Vessel movements will be regulated by the US Coast Guard during actual blasting activities.

5.2.1.3 Structural Evaluation

Prior to dredging or blasting operations, a detailed survey of existing infrastructure will be performed. This survey will include a review and documentation of the harbor structures that may be impacted by the proposed activities. The location of critical structures will be determined and recorded on control documents. Structure condition will be described and a photographic record will be made. Pre-project conditions will be clearly identified. A condition report of each structure will be prepared by the blasting contractor and provided to each facility owner prior to any construction activities. A survey of the existing channel and berth areas included within the project bounds will be performed to identify and locate all submarine utilities. The survey will encompass a review of record drawings maintained by utility companies, including but not necessarily limited to: Boston Edison Company; Metropolitan District Commission (MDC) Water and Sewer Divisions; Boston Gas Company; Massachusetts Water Resource Authority; and private marine facilities. The survey will identify the location of all utility elements and will identify specific means for protection or relocation during the dredging and/or blasting operations.

5.2.1.4 Regulatory Constraints

All construction activities related to the dredging of silts and parent materials and

the removal of rock from the project area and thin disposal will be performed under the conditions established within the permits issued for this work. These permit documents may identify specific environmental performance criteria which must be satisfied. Berth areas will require individual permits with a special condition that vessels moored at the berth shall not extend into the federal channel.

5.2.1.5 Seasonal Limitations

The movement of anadromous fish will require the limitation or stopping of dredging activities in the Mystic River and Inner Confluence during the spawning period between 1 February and 15 June. Blasting will also cease during that period. If agreeable to the State regulatory agencies, monitoring may be conducted to determine if dredging and disposal can continue during this time frame in the Mystic River and Inner Confluence.

5.2.2 Dredged Material Handling Procedures

The proper handling of dredged material will assure that potential impacts to the environment are minimized. The following sections characterize the general procedures which will be used throughout the project.

5.2.2.1 Monitoring Requirements

During dredging operations, activities of the contractor will be observed by the Corps on-site construction management staff. This staff will be directly responsible to the Contracting Officer. In addition to monitoring and verifying the dredge position (particularly important in areas of known utility crossings), this staff will also assure compliance with required permit conditions.
Specific comments to this DEIS/R requested independent monitors to be on the contractors vessels. While the Corps would not object to an onboard observer, there are safety and liability issues to be addressed. The Corps does not typically fund this type of activity although it does contract with a dredge inspection firm which verifies disposal locations for contract and permit compliance. The independent observer can alert the Corps inspector of any perceived permit violations. However only the Contracting Officer can modify or halt dredging and disposal operations.

5.2.2.2 Environmental Bucket

Dredging of the silt materials will be performed with an enclosed "environmental" bucket. The bucket is specifically designed to reduce sediment loss during closure and is provided with rubber seals to minimize loss of fines as the bucket is drawn up through the water column. There are several manufacturers of such buckets. The key features of these proven systems include those design innovations which minimize the generation of resuspended sediments during all phases of the bucket operation.
Traditional buckets remove a concave bowl shaped cut from the channel bottom, whereas some environmental bucket designs make a uniform horizontal cut in

the sediments. This type of an environmental bucket enhances the ability of the operator to make a uniform cut of the channel bottom without performing secondary operations, such as dragging of the bucket to smooth any residual ridges, which tend to resuspend bottom sediments and increase turbidity. Modern environmental buckets include integral bucket covers which protect excavated sediments from being washed from the bucket as it is hauled through the water column. These covers are included with purge valves which reduce the effects of bucket impact during descent through the water and initial contact with the bottom, thus further reducing potential resuspension. Clamshell seal indicator switches are available to alert the operator when the bucket has not completely sealed.

5.2.2.3 Dredging Locations

Dredging will be performed in the Federal channel in the Chelsea Creek and in portions of the Federal channels in the Mystic River and Reserved Channel. Dredging of some private berths, adjacent to these channels, will also take place. In addition, several private berths located in the project area and located along the main ship channel will be taking advantage of the opportunity to dispose of silt material dredged from their berths at the disposal sites constructed as a part of the BHNIP. For a detailed description of the project, the reader should refer to Section 2.0 of this document.

5.2.2.4 Facility Construction

Construction of land-based facilities is not anticipated. Sand used as capping material, will be loaded at existing terminal facilities situated throughout the harbor or barged into the harbor depending on the contractor source of the sand. Off loading of trash and debris, which cannot be placed in the in-channel disposal cells, will require pier space for temporary storage and transfer to an approved landfill. It is anticipated that the trash transfer operation will be intermittent and require a relatively small area. In the event that contingency plans for upland disposal of a small portion of the silt materials is required, a dredged material dewatering operation would be temporarily established at a waterfront site. This would only be implemented if the in-channel disposal storage volume was not sufficient to contain all of the silt material and disposal of small volumes of material at the Little Mystic channel was not available. The dewatering operation would consist of either diking or of mobile mechanical equipment.

5.2.3 Dredging Sequencing

The following paragraphs identify the mechanism and rationale for determining the dredging priorities for the BHNIP.

5.2.3.1 Site Prioritization

The location for the start of dredging will be governed by the time of year that the project begins. For example, if the contractor were to get underway during the environmental restriction time period, they

would be directed to work initially in the Chelsea Creek and Reserved Channel. If no restriction is in effect, the contractor will be directed to begin dredging in the Mystic River. Scheduling for the dredging and preparation of in-channel silt disposal cell facilities in the Mystic River is critical to ensure a sufficient number of cells available for disposal of contaminated silt from the Reserved Channel. If the Mystic River disposal cells are restricted or prohibited during dredging of the Reserved Channel, then the Chelsea Creek cells will be used until such time as the dredge plant operating in the Reserved Channel can be moved to the Mystic River or Inner Confluence. Use of the Mystic River in-channel disposal cells for material from the Inner Confluence and Chelsea Creek may be necessary to assure availability of cells for the Reserved Channel contaminated silt.

5.2.3.2 Material Prioritization

It is estimated that over 1.3 million cubic yards of dredged material storage volume will be created during the excavation of the in-channel disposal facilities. This volume was estimated by examining the seismic records made during November 1992 which indicate the subsurface composition. The depth of subsurface information was limited to -55 ft (MLW) in several locations. However, additional capacity may be realized if the contractor is able to dredge deeper than -55 ft (MLW).

To create the in-channel disposal cells, the contractor will be directed to dredge as deep into the exposed parent material as practical with the equipment available. Some areas will support excavation to as much as -70 ft (MLW). The practical limitations to the depth of dredging will be dictated by the geotechnical stability of the dredge cut and by the proximity and integrity of any adjacent structures. Dredging too close to a structure or dredging soils which will slough excessively may lead to undesirable structure movement.

It is estimated that the volume of silt to be dredged is approximately 1.1 million cubic yards and that it can be expected to expand to 1.3 million cubic yards as a result of dredging and handling. It appears that the in-channel disposal areas will accommodate the Federal channel silt and the material to be dredged from the berths which have been identified as direct project beneficiaries. Any significant increase in dredging volumes and/or required in-channel disposal volumes will require that additional disposal capacity be found during construction. Some of the remaining material dredged from the berths could be placed either in the Little Mystic Channel or sent to an upland site. This is discussed further in paragraph 5.6.2.3 of the Contingency Plan section of this document. Material dredged from these berths will receive preference over non-beneficiary facilities.

5.2.3.3 Schedule

As mentioned in previous sections, the schedule for dredging will depend upon the requirement to construct the in-channel disposal cells prior to dredging of silt materials. Scheduling of operations will

include consideration of the restriction of activities in the Mystic River and Inner Confluence during 1 February to 15 June due to expected environmental limitations.

It is anticipated that Federal funding will allow the BHNIP contract to be bid during the winter of 1996-1997 with award and "notice to proceed" expected during the early spring of 1997. The contractor would be directed initially to construct in-channel disposal cells in the Chelsea Creek. A portion of that work will require the dredging and temporary storage of approximately 9,000 cy of silt in scows. Dredging of contaminated silt in the Reserved Channel would start as soon as the Chelsea Creek in-channel disposal cell(s) were available to receive material.

As soon as dredging is able to commence in the Inner Confluence and Mystic River, the contractor will be directed to transfer the dredging operations to those sites. Dredging must take place in the Mystic River and Inner Confluence throughout the entire available environmental "window". The contractor would proceed with dredging and construction of in-channel disposal facilities in the Mystic River and Inner Confluence until those reaches were completed. These operations would be terminated if they were not completed before the following environmental restriction period. It is possible that a dredge operating in the Mystic River or Inner Confluence would have to be moved to the Chelsea Creek to prepare in-channel disposal cells for use during the restricted period. These flexible operations may be necessary to maintain continuity and to keep the project on schedule. This would mean Chelsea silt would be disposed in the Mystic River rather than its own river bed, thus creating cells to be used later.

5.2.3.4 Limitations

Since in-channel disposal cells will be constructed by dredging silt and then parent material, an obvious limitation to the continuity of operations is that of not having in-channel cells available when needed for disposal. If silt can not be placed in the disposal cells, then parent material cannot be dredged, thus effectively stopping construction of disposal cells. The construction management team will be responsible for assuring that in-channel cells are always available for contaminated silt disposal. As a contingency, a limited quantity of silt material could be temporarily stored on scows until parent material can be removed and the disposal facilities made available. When working in the Chelsea Creek and Reserved Channel, each cell constructed above the Chelsea Street Bridge will store an average of 31,000 cy of silt. Approximately 9,000 cy of that material will have been dredged in the process of creating the disposal cell facility. Therefore, silt brought in from dredging of the Reserved Channel will require careful monitoring to avoid exceeding the cell capacity in the Chelsea Creek. It may be beneficial to delay dredging in the Reserved Channel until sufficient cell capacity exists in the Chelsea Creek.

Dredging operations will be performed in active commercial channels. The dredging Contractor will be required to accommodate the passage of vessel traffic. Since the Chelsea Creek channel is

relatively narrow, the contractor will need to periodically shut down the dredging operation and move out of the channel to let traffic pass.

5.2.4 Blasting and Rock Removal

Significant volumes of rock will need to be removed from several areas for the BHNIP. Silt and parent material will first be removed by dredge from the specified areas to expose the underlying rock. Holes, drilled in the rock by barge mounted drill rigs, will be filled with explosives. Vessel traffic will be cleared from the area and the explosives will be detonated, resulting in loose fractured rock that will be dredged by mechanical means. The excavated rock will be placed in scows or on barges for transportation to an unconfined disposal site, used as an armor layer for the sand cap, or used for commercial purposes. If the rock is used for upland commercial purposes, truck traffic can be expected to be moderate since production of the blasted rock will occur at different periods during the construction of the project. At present, there is no known commercial use for the rock.

5.2.4.1 Locations

Approximately 88,000 in-situ cy of rock will be removed from the mouth of the Reserved Channel, the Inner Confluence, and from the Mystic River Channel. All of the rock is located within the Federal Channel reach. It is estimated that 34,000 cy of rock will be blasted and dredged from the maneuvering areas of the Main Ship Channel at the mouth of the Reserved Channel. The remaining 54,000 cy of rock will be taken from the Inner Confluence and Mystic River Channels.

5.2.4.2 Seasonal Limitations

The same seasonal limitations described in Section 5.2.1.5 apply to rock removal operation.

5.2.4.3 Mitigation

In addition to imposing seasonal restrictions upon the blasting operations, specific mitigation techniques will be employed to further reduce the potential impacts of blasting. Fish behavioral or other devices will be used to startle, frighten or deter fish from the blasting area during operations. Sonic startle devices or pneumatic bubble barriers will be evaluated as fish deterence devices to induce fish to leave the critical area and thus reduce mortality.

5.3 DREDGED MATERIAL DISPOSAL OPERATIONS

The following sections describe the general operations associated with disposal of the dredged materials. These descriptions focus primarily on the anticipated in-channel operations.

5.3.1 Equipment and Facilities

The basic equipment which a Contractor would use for in channel disposal

operations will likely consist of a tug and nominal 3,000 cy scows. At least two (2) scows will be used to service each operating dredge.

Parent material will be transported by tug and scow to the MBDS. The tug must be of sufficient size to control a 3,000 or 4,000 cy scow on the open sea in all types of weather. A minimum of two (2) scows for each dredge will be required since the round trip time to the MBDS is about 8 - 10 hours. One scow will receive dredged material as the other is transported offshore for dumping. The disposal site will be identified by a buoy and each tug will have onboard a dredge inspector to verify disposal location.

5.3.2 Impacts on Dredging Operations

The difficult scheduling requirements created by the in-channel disposal option is expected to impact the dredging operation. The frequent changing of buckets will probably take place during the time scows are being shuffled and taken away for disposal. The dredge will need to cover the same area of channel at least twice - once for silt material and once for parent material. While dredging the parent material, the dredge will remain in one location longer because more parent material will be removed per area to create disposal space.

5.3.3 Weather Restrictions

Disposal operations will be affected by both weather conditions and environmental restrictions. Disposal of parent material at the MBDS requires exposure to the sometimes harsh New England weather particularly during the winter months when cold temperatures and Nor'easter storms confront the towing vessel's crew. Tug captains will have the final say as to whether they will risk making disposal trips in stormy weather although the Contracting Officer's representative may direct against venturing out in rough seas. Typically, contract specifications allow for weather related delays.

Another type of weather related restriction to the disposal process will be the volume of vessel traffic on the Mystic River and Chelsea Creek. Winter weather will bring an increase in fuel deliveries to distributors on both of these rivers. Dredging and disposal operations will need to move equipment to let tankers pass. Because of the relatively short time for disposal, the delay caused by increased vessel traffic is not expected to be as great on the disposal operation as it would be on the dredging operations.

5.3.4 Capping Operations

Capping will be employed to isolate the silt material placed in the in-channel sites. The cap will be designed to act as a barrier during future maintenance operations, preventing the dredge bucket from penetrating into the disposed material. The DEIR/S contemplated use of parent material for capping. During discussions with state agencies it became clear that use of the predominantly clay parent material for capping was unacceptable due to unresolved concerns over the ability of the highly cohesive clay to spread out over the

cells to minimize voids in the cap. Another area of concern was the ability of the silts to support the clay cap. Finally, the constructability concerns regarding the ability to meet the tight tolerances required in the navigation channels (-42 feet MLW) with highly cohesive material, eliminated the use of clay as a capping material for the in-channel locations. Therefore, sand or granular parent material will be used for a cap.

The New England Division of the Corps has performed extensive capping projects and monitoring of capped disposal areas, primarily in Long Island Sound. An extensive capping and monitoring bibliography in included in this FEIR/S in the references section found in Chapter Nine. As part of their studies, the Corps obtained core samples from a variety of disposal sites in the Long Island Sound. Analysis of the split cores showed that the cap and contaminated material interface was easily discernable in most cores. More importantly, a mixing zone of less than 10 cm (approximately 4 inches) was observed. This zone was identified by a boundary signature appearing in the chemical analyses that were performed on the cores at 20 cm intervals. The contamination profile of the sediments below the cap abruptly changed at the cap/silt interface to below detection limits within the cap material (see Figures 5-1 and 5-2).

Although the contractor will be required to develop a specific method for placing a nominal 3-feet of granular capping material; it is generally understood that the cap material will be spread on individual cells as filling with silt is completed. Spreading the cap materials will be done by partially opening the doors on split hulled scows and gradually releasing sand as it moves over the cell. A survey of the trench will be required prior to placement of the cap. The contractor may be required to drag a heavy beam along the top of disposed silt prior to placement of the cap to prevent the cap from protruding above the -42 ft (MLW) datum and to maintain cap thickness as uniform as practicable. If imported sand is required, it will be loaded onto scows at a harbor facility. A final survey will be required after capping is completed to verify operating depths.

5.4 CONSTRUCTION SEQUENCING

5.4.1 Dredging and Disposal Sequencing

Construction of the BHNIP will require about 18 months. This will vary depending on the contractor awarded the job and the job and the equipment brought to the job. Because of the length of time over which the dredging will take place, the restricted dredging period (to protect anadromous fish runs) in the Mystic and Inner Confluence will impact on project scheduling. It is assumed that a contractor will use two dredging plants in order to minimize dredging time. However, this complicates the scheduling of dredging locations and production rates. A detailed example scenario using two dredges has been worked through and is included in Appendix J and is summarized on Figure 5-3. This scenario is only to serve as a guide and to show that the sequencing can work. A contractor will probably modify

the sequencing to meet equipment and weather needs.

The primary goal of scheduling is to keep both dredge plants in full production at all times. Another objective is to minimize storing silt in scows/barges. Cells must be ready to accept silt material when silt material is being dredged. Initially silt will be stored in scows while the first cell is being prepared. Depending on the number of scows available for storage, the initial cell may be smaller than suggested in the scenario. However, as long as the storage cells are dug deep enough there will be adequate capacity for the silt removed from the top of the cell and several adjacent cells. Once a cell is prepared it typically will have capacity to store about three times the silt removed to create the cell. In this fashion, the contractor can "get ahead" or fill cells with material from another tributary or berth.

The example scenario which has been worked through, begins in April (year 1) when dredging is expected to be prohibited in the Mystic and Inner Confluence. A single dredge plant would begin just upstream of the Chelsea Street Bridge and begin creating cells progressing upstream. By early May, three cells should be prepared and a second dredge plant begins in the Reserved Channel. As the Chelsea dredge continues to create four more cells by mid-June, the Reserved dredge has alternated between dredging silt and parent material as cell capacity is created in the Chelsea.

In mid-June the dredge working in the Chelsea Creek moves to the Mystic River just upstream of the Tobin Bridge. Likewise, the dredge from Reserved Channel moves to the Inner Confluence. Silt produced by both dredges is initially sent to cells in the Chelsea Creek until cells are prepared in the Mystic and Inner Confluence. Once cells are established in the Mystic and Inner Confluence, the process of creating cells and disposing silt in these areas will continue until the end of January (year 2) in the Mystic and the end of November in the Inner Confluence. It should also be noted that berth owners must arrange to have the berths dredged at the appropriate time. This scenario assumes the owners will contract with the Corps' contractor who is on site and will be able to adjust berth dredging to accommodate disposal cell availability.

By the end of November, the dredge working the Inner Confluence has completed all cells and dredged all berthing areas of both silt and parent material, that dredge will then move back to the Reserved Channel and produce silt for cells in the Mystic. This dredge will be finished producing silt near the end of December and will proceed to remove parent material and rock from the Reserved Channel. This dredge will be demobilized when finished with the Reserved Channel early in March.

Meanwhile, in late January, the dredge working in the Mystic River will move back to the Chelsea Creek to continue where it left off and will ship its first cell's silt back to the Mystic. After completing the upstream cells, the dredge will move to the Lower Chelsea Creek. No cells would be created below the Chelsea Street Bridge during the initial improvement project.

This area would be available for future maintenance dredging operations. It appears the dredge may finish in the Chelsea Creek about mid-May and cannot return to the Mystic until mid-June. Between mid-June and the end of October, the dredge will finish creating cells and dredge the berths in the Mystic and any rock removal necessary.

Since scheduling is subject to change daily due to weather conditions or equipment problems, there may be times when silt may have to be stored on scows as done during the initial dredging. Dredging may be required to slow down in order to meet an environmental requirement or it may become necessary, provided regulatory agencies permit it, to work into the environmental window in the Mystic and Inner Confluence.

5.4.2 Project Demobilization

Following completion of the dredging and disposal operations, all equipment and personnel will be demoblized from the site. A final survey will be performed to determine the post-dredging bottom conditions. Final drawings, which show the location and depth of all material placed at the in-channel disposal facilities, as well as the location and depths of the cap system, will be prepared. A post-construction survey of all potentially impacted infrastructure will be performed to determine the extent of damage which may have resulted due to the dredging and/or blasting operations. This survey will include a review of claims which may have been made by structure and utility owners. Any temporary utility relocation or protection works which may have been installed prior to dredging will be removed. If damage is detected, it will be the contractor's responsibility to repair the damage. The project must have been completed according to specifications before it will be accepted by the Contracting Officer.

5.5 SUMMARY OF CONSTRUCTION MITIGATION

This Plan has identified specific techniques to be employed during the various critical operations throughout the project which will minimize impacts of the project. The following sections summarize these recommended actions.

5.5.1 Dredging

Dredging operations will be required to meet specific performance criteria during all activities. Removal of contaminated silts will be performed with a closed "environmental" bucket with a capacity between 15-22 cy. which has been proven to reduce turbidity levels resulting from dredging operations. One of the most effective mitigation measures which could be implemented would be to require the dredge operator to meet minimum competency and experience criteria. Operator skill can be exploited to assure efficient and low impact dredging.

The "environmental" bucket has been successfully used to minimize turbidity in the immediate vicinity of dredge sites. The bucket is specifically designed to reduce sediment loss during closure and is provided with rubber seals to minimize loss of fines as the bucket is drawn up through the water

column. Restricting the bucket drop velocity and haul speed will further minimize the potential for increased turbidity in the water column due to dredging. Silt curtains will be deployed around the dredging and disposal cells to further minimize turbidity in the immediate vicinity of the active work area.

All construction activities related to the dredging of silts and parent materials and the removal of rock from the project area will be performed under the conditions established within the permits issued for this work. It is anticipated that these permit documents will identify specific environmental performance criteria which must be satisfied.

5.5.2 Rock Excavation

Blasting of rock in the Mystic River and Inner Confluence areas where anadromous fish have been observed will not be performed between 1 February and 15 June. Also, appropriate fish deterence devices will be employed to minimize fish mortality during blasting.

5.5.3 Dredged Material Disposal

Dredged material disposal will require the dumping of dredged silts from scows into the prepared in-channel facilities. Disposal of parent materials will be at MBDS unless the material can be beneficially used at an upland site and the scow can be off-loaded immediately.

5.6 MONITORING DURING DREDGING AND DISPOSAL OPERATIONS

Monitoring during dredging and disposal may be required to comply with environmental permits. It will be the responsibility of the Contracting Officer to implement and execute these requirements. The monitoring program if required, will identify specific minimum performance criteria which must be satisfied to safely, effectively, and responsibly complete the required dredging and associated activities. Performance criteria may involve readily quantifiable and measurable parameters such as turbidity, depth and planar distribution of deposited sediments.

5.6.1 Dredge Performance

The critical performance parameters which will be continuously monitored during dredging operations will include specific production and performance data and position verification. Also monitored will be the amount of parent material mixed in with the silt. Too much clay will indicate a change in procedure may be needed to avoid filling the in-channel cells with clean material.

Dredge performance is quantified by continuously monitoring the volume of material removed as a function of time. An accounting of the number of cycles performed by the dredging bucket over a fixed period can form the basis for an estimate of dredged quantities, assuming the bucket removes approximately the same quantity in each cycle. A complementary technique requires maintaining a count of the numbers of scows which are filled to the load

line and hauled to the disposal site. The volume of dredged material is approximated based on the displaced volume of the scow and the estimated specific weight and water content of the material. The estimated volume is typically factored to account for the increase in volume of the dredged material as compared to the in-situ volume.

The volume of each scow is documented and a cumulative estimated total of dredged volume is maintained by the Project Engineer. Periodic hydrographic surveys of the project site are typically performed to determine more precisely the quantities of material dredged from the project site. These surveys are performed in accordance with the standards established by the US Army Corps of Engineers, Engineering Manual No. 1110-2-1003, 28 February 1991. Specific procedures and acceptable quality control standards for surveys performed for construction administration, payment, and project acceptance are defined in this universally accepted manual. Volumes will be determined by a comparison of the pre-dredge hydrographic survey with the post-dredge survey. In-place volumetric differences within the payment prism will be computed as the difference between those surveys.

Positioning of the dredge during dredging operations and maintenance of horizontal and vertical control during hydrographic surveys are related critical issues. The US Army Corps of Engineers, New England Division, maintains a series of benchmarks throughout Boston Harbor which provide accurate references for elevation and position. These benchmarks, complemented by temporary control points which reference these benchmarks, will be used for all survey measurements. All horizontal positioning will be referenced to the State Plane Coordinate System and will be accurate to within 3.0 meters. Depth measurements shall be referenced to the National Geodetic Vertical Datum of 1929 (NGVD) and shall show the local Mean Low Water Datum (MLWD) as referenced to NGVD. All vertical depth measurements shall be limited to a standard error not to exceed 0.5-ft. These requirements meet the standards for Class 1 surveys.

Disposal activities, such as the positioning of a scow during dumping operations, will not ordinarily require the accuracy of a Class 1 survey. Positioning of those scows to within approximately 5.0 meters will be sufficient. Monitoring of potential movement of the dredged materials placed at the disposal sites will be performed to the more demanding accuracies required of a Class 1 survey, due to the need to accurately determine the fate of the placed materials.

The daily operations of the dredge will include repositioning of the dredge a number of times. In addition, the dredge bucket will be lowered to the bottom and material will be hauled from the bottom approximately once per minute. Positioning can be verified by several methods, all of which satisfy the accuracy requirements of a Class 1 survey. These methods include: positioning by pre-established and surveyed rangelines and reaches; location by land-based survey instruments to establish the range and azimuth of the dredge from a known benchmark; and positioning by satellite using a differential Global Positioning System (GPS). The depth of excavation will be continuously monitored by the dredge

operator using a bucket mounted pressure transducer compensated for transducer position and bucket geometry. The operator will also mark and calibrate the bucket suspension and closing lines to provide a visual check of digging depth. The dredge operator will establish visual and electronic tide gauges to continuously compensate the digging depth for water surface elevation variations.

5.6.2 Environmental Impacts

Potential impacts to water quality will occur within a relatively constant distance from the dredging operations. An estimate of plume size based upon recent models (see Appendix F) is approximately 500-ft from the dredge.

Mechanical dredging operations can be expected to result in 3-5% of the total dredging quantity being brought temporarily into suspension. It is therefore possible that contaminants will be released to the water column as a result of this resuspension. The difficulty arises with variations across the project areas in current, water depths, fresh water input, CSO discharges, sediment physical characteristics, and other point sources which will all contribute to actual turbidity levels around the dredge site. In addition, dredging methodologies employed, such as production rate, barge overflow, and careful bucket operation, can have an even greater impact upon turbidity levels at the dredge site.

5.6.3 Accountability and Supervision

Contract documents will clearly define the levels of responsibility and lines of authority for the sponsor, Contracting Officer, and Contractor. The Contracting Officer will be designated by the US Army Corps of Engineers and will be responsible only to the project sponsor, Massport. The Contracting Officer will not be responsible for berth dredging or utility relocations, removals or production unless a special agreement is executed between the Corps and Massport. The Contracting Officer will be responsible for implementing all terms of the contract and for assuring that all conditions of the project permits are satisfied. The Contracting Officer will employ, at his/her discretion, various experts to assist with contract administration. For example, the Contracting Officer may designate a firm that specializes in environmental data acquisition to monitor water quality at the dredging and disposal sites. Other specialists, retained to support the Contracting Officer, could include licensed surveyors and/or hydrographers to monitor and verify all dredging depths, volumes, and critical disposal information and on-board inspectors to monitor dredge production and to verify that proper procedures are employed during disposal operations.

It is likely that other project experts will be directly responsible to the Contracting Officer. Critical mitigation tasks such as installation and operation of fish behavioral devices and pneumatic blast wave attenuation systems are not within the typical areas of expertise provided by construction contractors. Successful implementation of these critical systems can be more reliably assured if performed by specialized professional firms directly responsible to the Contracting Officer.

All of the project personnel, including the dredging contractor, scientists performing monitoring, mitigation specialists, and others, will be responsible to the Contracting Officer. The Contracting Officer will maintain authority over work in the federal channels. Massport and/or private berth owners will be responsible for all work outside of the channels.

5.7 LONG TERM MONITORING OF DISPOSAL SITES

The long term monitoring program for the selected aquatic dredged material disposal will be based upon the tiered approach presented in the Disposal Area Monitoring System (DAMOS) protocol.[1] DAMOS evaluates impacts to specific targeted resources to establish a threshold of effects to the general environment.

5.7.1 DAMOS Monitoring Program and Parameters

The Disposal Area Monitoring System .(DAMOS) is a program begun in 1977 by Corps' New England Division (NED) to manage New England's regional dredged material disposal sites. The program's main objectives are to minimize and manage the potential impacts of dredged material disposal on the marine environment. DAMOS is the most extensive dredged material disposal site monitoring program in the world and has conducted numerous published investigations of dredged material behavior and effects.

Monitoring priorities are determined based on: 1) the nature and volume of sediments disposed at the various disposal sites; 2) relevant findings of prior monitoring; and 3) discussions with State and Federal resource agencies. Typically, the most heavily used sites are monitored on an annual basis, while the less heavily used sites may go several years between monitoring surveys.

Monitoring of dredged material disposal sites has four primary objectives: 1) assuring that disposal operations are completed, and comply with permitted performance standards; 2) verifying that disposal materials and the interaction of the benthic community behave as predicted during project design modeling; 3) providing information that will also optimize utilization of the disposal sites; and 4) assuring that disposal activities are in compliance with environmental laws and regulations.

To address these objectives, monitoring parameters must respond to, at a minimum, the following questions:

- What physical and chemical environmental effects are associated with the proposed dredged material disposal activities; and
- What biological responses are associated with those physical or chemical effects?

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[1] Germano, J.D., and D.C. Rhodes, and J.D. Lunz, 1994. *An integrated tiered approach to monitoring and management of dredge material disposal sites in the New England Region*, Contribution No. 87, Report No. SAIC-90/7575&234. SAIC, Newport, R.I., pp.55 with appendices.

Specific sampling plans must be designed within this context, and, the pre-existing environmental conditions of the disposal site(s), and any sensitive receptors and/or risk pathways associated with on-site resources and the user populations.

5.7.2 Sampling Plan

Typical monitoring at disposal site(s) will consist of a depth (bathymetric) and sediment profile camera survey (e.g. REMOTS). Monitoring of in-channel placement locations will be conducted as part of the project construction and will consist of depth surveys to assure that minimum navigation depths are not impacted. It is anticipated that the surveys will be used to document the placement of material at the site and to confirm the expected recovery of the benthic organisms after disposal ceases. Similar surveys at MBDS, following the disposal of material from the dredging for the Third Harbor Tunnel, indicated the continued development of a large disposal mound and healthy benthic recolonization.[2],[3]

REMOTS scanning will provide an opportunity to evaluate the as-built conditions of the disposal cells or mounds. Conditions such as visual grain size and/or re-colonization anomalies suggesting unanticipated disposal materials response can be easily determined. Based on visual estimation of the photographic anomaly, further action(s) may be determined if necessary (e.g. chemical or bioassay analyses).

REMOTS scanning also provides an opportunity to indirectly evaluate biological resource conditions using trend or surrogate means. This approach establishes a hierarchy of trend or surrogate measures that provides a foundation for resource evaluation. As an example, the enumeration of polycheate tubes at the sediment-water interface, is a surrogate measure for:

- Densities of opportunistic colonizing polycheate species, which is a surrogate measure for:
- The rate of benthic secondary production of prey species, which is a surrogate measure for:
- Life history impacts of commercially important demersal fishery species, which is a surrogate measure for;
- An early warning signal that disposal impacts may affect human health.

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[2] SAIC, 1994a. *Baseline Survey of the Massachusetts Bay Disposal Site: Final Designation, 14 September 1993.* Draft DAMOS Report, Submitted to the U.S. Army Corps of Engineers, New England Division, Waltham, MA.

[3] SAIC, 1994b. *Monitoring Cruise at the Massachusetts Bay Disposal Site, August 1994.* Draft DAMOS Report, Submitted to the U.S. Army Corps of Engineers, New England Division, Waltham, MA.

Benthic surveys conducted to evaluate the site alterations show that conditions within the Mystic River, Inner Confluence and the Chelsea Creek are already of low benthic resource value, and therefore both biological and chemical monitoring is unwarranted. In the short term, the project will improve benthic conditions. However, should areal conditions (e.g. CSO discharges and runoff) remain unchanged, post-construction sediments should return to pre-project conditions. Because a granular cap is replacing the existing surface silt layer, a temporary shift in the benthic assemblage from silt-loving to sand-loving organisms and then back again when the silt returns should be expected. Also, this pre-project sediment condition is not isolated to the channel, rather the channel is reflective of the greater harbor.

5.7.3 Reporting Requirements

Results of the long term monitoring investigations conducted under DAMOS will be prepared in report form, reviewed, and published as a DAMOS contribution. The DAMOS contributions are distributed to regional State and Federal resource and permitting agencies for review and comment; the interested public, and many regional college and university libraries (such as UMASS Boston, Woods Hole Oceanographic Institute, etc.) as public information.

5.8 CONTINGENCY PLANS

A key element of the properly managed dredging operation for the BHNIP will be the identification and planning for anticipated problems which may develop. The following sections describe environmentally related contingencies, which could be implemented when such problems are encountered. It must be recognized that these identified contingencies do not necessarily exhaust all possible operating scenarios. It is anticipated that the Contractor will be required to develop a detailed Contingency Plan as part of the contractually required submittals. These contingencies would be identified in the *Accident Prevention and Site Emergency Plan and the Environmental Protection and Turbidity Control Plan.*

5.8.1 Project Delays

Any long term marine construction project may be subject to periodic delays resulting from any number of causes. Reasonable delays are typically factored into the overall schedule for the project. A detailed Project Schedule will be developed at the start of the project. The Corps, Massport berth owners and contractor will participate in the development, review, and approval of the schedule. The progress of the BHNIP will be continuously monitored by the Contracting Officer. Any prolonged delays which could impact critical milestones, such as meeting specific environmental milestones or permit conditions, will activate contingency plans. The cause of the delays will be critically reviewed and procedures will be implemented to eliminate those delays.

To assure that Contractor delays will not be extended and potentially threaten completion of the project, the Contracting Officer will have the authority to require the mobilization of additional equipment and personnel as may be required. The Contractor will be obligated to provide the

proper equipment and labor, at his/her cost, to perform the contracted services within the established time schedule. Delays caused by conditions which are not within the control of the Contractor, such as weather related phenomena, water quality degradation due to a non-project related occurrences, or other uncontrollable conditions will be treated in a similar manner. The Contractor will be required to mobilize additional personnel and equipment, as may be required, but will be compensated for providing that contingency.

5.8.2 Operations Issues

There are many issues associated with the effective and successful execution of the dredging, blasting, disposal, and support operations for the BHNIP that may trigger contingency requirements. These are described in the following paragraphs.

5.8.2.1 Operator Qualifications

It is essential that the most qualified and experienced persons be employed in critical roles for all aspects of this project. One of the most crucial positions is that of the dredge operator(s). Experience has shown that the skills of the dredge operator will be fully exploited to ensure that bucket dredging is performed with minimal impact to water quality. The operators must be keenly aware that bucket impact on the channel bottom, closing speed during excavation, haul speed through the water column, surface breaching techniques, and scow loading operations are all potential sources of turbidity. Turbidity must be minimized during all project operations, but especially during the dredging of the silt layer.

The Contracting Officer will contractually require the Contractor to employ dredge operators with demonstrated exemplary skills. The Contracting Officer will reserve the right to require the Contractor to replace any operator that does not meet minimum skills or does not demonstrate an ability to satisfy the performance parameters demanded by this project.

5.8.2.2 Trash and Debris Management

It is recognized that the proposed activities will likely encounter various types of trash and debris on the channel bottom and in the berth facilities. The dredge plant will be capable of removing and managing most, if not all, of these materials.

Several contingencies must be considered. The Contractor will be required to contain and collect all floating debris which result from the dredging operation. Floating debris and solid trash will be collected and placed into containers which will be maintained on the dredge or support barge. This debris will be periodically offloaded and transported to an appropriate landfill for proper disposal. Dredging operations may periodically release petroleum products which are entrapped in the bottom sediments. During dredging these oils may be released and consequently collect on the water surface. The Contractor will be required to maintain sorbent booms and clean-up materials to immediately eliminate any such surface impacts.

While it is unlikely that unforeseen containers or drums containing unknown and possibly hazardous materials will be encountered, it will be prudent to include such occurrences in a contingency plan. The Contractor will be

required to submit, as part of the *Accident Prevention and Site Emergency Plan,* a detailed procedure for handling and managing unknown containers. At a minimum, this contingency will include required response notification protocol, testing requirements, health and safety procedures, drum handling procedures, diving support as required, and disposal requirements.

5.8.2.3 Disposal Operations

The critical elements of the disposal operation include: construction of the in-channel disposal cells; placement of the dredged silts into the disposal cells; containment of turbidity which may result from the disposal operations; and installation of the cap system. Each of these tasks will be planned and executed with some inherent risk. The design process is specifically required to minimize risks. Development of contingency plans for those elements of risk which are difficult or impossible to quantify will further assure the successful completion of the project. The following paragraphs identify three disposal operation contingencies.

Design of the in-channel disposal facilities is constrained by the geotechnical properties of the parent material, the approximated stability of contiguous structures, and the assumed bulking properties of the silt materials. It has been estimated by the Corps that 1.1 million in-situ cy of silt will bulk to approximately 1.3 million cy requiring in-channel disposal. The available capacity of the in-channel facilities has been estimated by the Corps to be only slightly more than 1.3 million cy. It is clear that a modest variation in any of the factors affecting the disposal volume approximations could require alternative disposal plans. Because of the expected small quantity, upland disposal of these materials or use in an ecological improvement project in the Little Mystic River could accommodate those silts which might not fit into the available in-channel facilities. It should be clear, during the initial disposal phases of the project, if the volume allowances and bulking assumptions were adequate.

It may be effective to restrict scow dumping procedures to times of slack tide. Maximum tidal velocities through Boston Harbor occur approximately 3.5 hours after low water and about 4 hours after high water. Slack tide occurs at the time of high or low water. Migration of any turbidity plume, which may result from the dumping operation, would be minimized by avoiding times of peak tidal velocities.

5.8.2.4 Permit Conditions Exceeded

The BHNIP will be constructed under the conditions of the environmental permits dictated by the appropriate regulatory agencies. Significant exceedance of the allowable levels for turbidity and other possible monitoring parameters may require a modification of the operation which causes the exceedance. The first requirement of the project monitoring staff will be to quantify the exceedance and identify the specific source of the exceedance. If the source is not project related, dredging, disposal, and/or rock removal operations would continue. If the significant exceedance is clearly caused by the BHNIP construction operations, remedial action alternatives will be evaluated.

The Contracting Officer will identify the appropriate contingency to mitigate the exceedance. The Contractor will be required to immediately implement the required contingency.

In the event that no appropriate contingency plan is available, the Contracting Officer shall develop a specific procedure. If appropriate, that procedure will be reviewed with appropriate regulatory agencies and implemented with their approval. These agencies must recognize that an immediate response to such field modifications will be essential. Each agency should identify a responsible contact person, who will be available at all hours with authority to approve procedural changes.

5.8.2.5 Equipment Failure

Contractor equipment failure will not be allowed to impact the project schedule or affect the water quality conditions imposed as a part of the project contract. The Contractor will be required to immediately repair any failed equipment or to replace critical equipment to the satisfaction of the Contracting Officer.

5.8.3 Environmental Conditions

Any marine related construction activity is subject to the inclement weather. Responsible Contractors are experienced in dealing with weather related impacts. Project specific concerns include the possible effects of dredging related noise and odors on the areas in the immediate vicinity.

5.8.3.1 Weather Related Issues

Normal weather phenomenon do not typically impact dredging operations. Blasting activities may be sensitive to precipitation. However, extreme weather can significantly impact the proposed activities. The Boston area is subject to periodic severe northeast storms and to seasonal hurricanes. Extreme water surface fluctuations, high winds, and intense precipitation are characteristics of such events. The duration of these events rarely exceeds several days, with the most intense activities lasting a matter of hours. Modern forecasting techniques will typically provide adequate time to secure the construction equipment and to implement procedures for the protection of life and property. The approved *Accident Prevention and Site Emergency Plan* will identify specific procedures for evacuating personnel and for safely securing floating equipment in the event of such severe weather.

Stability of the dredging, disposal, and blasting work in-progress will be a great concern during extreme weather events. Blasting operations would be terminated as far in advance of the predicted event as possible. All explosive materials will be removed from the site and stored at secure upland facilities which are likely to be at Massport owned waterfront industrial site depending on the blasting location. As part of the normal daily procedures, the disposal and capping operations must be carefully coordinated. Capping of the placed silts must be done as soon after placement as possible. Severe storm activity could potentially generate waves which could resuspend uncapped silts. Resuspended silts could migrate to areas outside of the disposal cells.

Interim hydrographic surveys of the work sites should be performed if possible. These surveys would indicate the position of the placed silts, capping material, and extent of completed dredging before any storm effects. Post-storm surveys would be performed in the same areas to evaluate the effects on the work sites. These surveys would provide vital information to the Contracting Officer and allow for the proper planning of repairs to any damaged sections of the cap and identify areas which might require re-dredging.

Precautions to prevent "short dumping" of clean parent material prior to arrival at the MBDS include: monitoring of weather and sea conditions, prohibiting the scow from leaving the harbor, establishing a point of no return and employing dredge inspectors to verify the disposal location.

5.8.3.2 Noise

The proposed areas to be dredged are all located within the Designated Port Areas of Boston Harbor. Periodic dredging is a necessary and normal activity within these areas. Noise associated with dredging is characterized by sources common to Port activities and is expected to be minimal. Limited reaches of the proposed project are situated in the vicinity of commercial and residential structures. Typically, the dredge will not operate in one position for any extended time. Dredging is a progressive operation and will expose any specific location to the associated noise for only a matter of weeks. It is anticipated that the dredge will operate continuously (24 hours/day 7 days/week).

5.8.3.3 Odor and Air Quality

Dredged materials will normally contain traces of organic matter and can generate distinct odors when removed from the channel bottom and placed in scows. Such odors are typically associated with the release of hydrogen sulfide and methane. Dredging of typical channel sediments will not normally release these gases at concentrations that could be harmful.

The odor associated with even low concentration releases of hydrogen sulfide and methane can be obnoxious. Scows will typically have a thin layer of water which covers the majority of the load. This cover will tend to minimize gas release. Released gas will be readily dispersed in the atmosphere. While odor can be of concern, it is not typical for odor issues to persist at projects, such as the BHNIP, where the material is being placed in submarine facilities. Odor problems are most often associated in the vicinity of permanent upland storage facilities. This will not be typical of the BHNIP operations.

Figure 5-1. Cu and Zn Concentrations 11 Yrs. After Placement: Interface at 80 to 100 cm

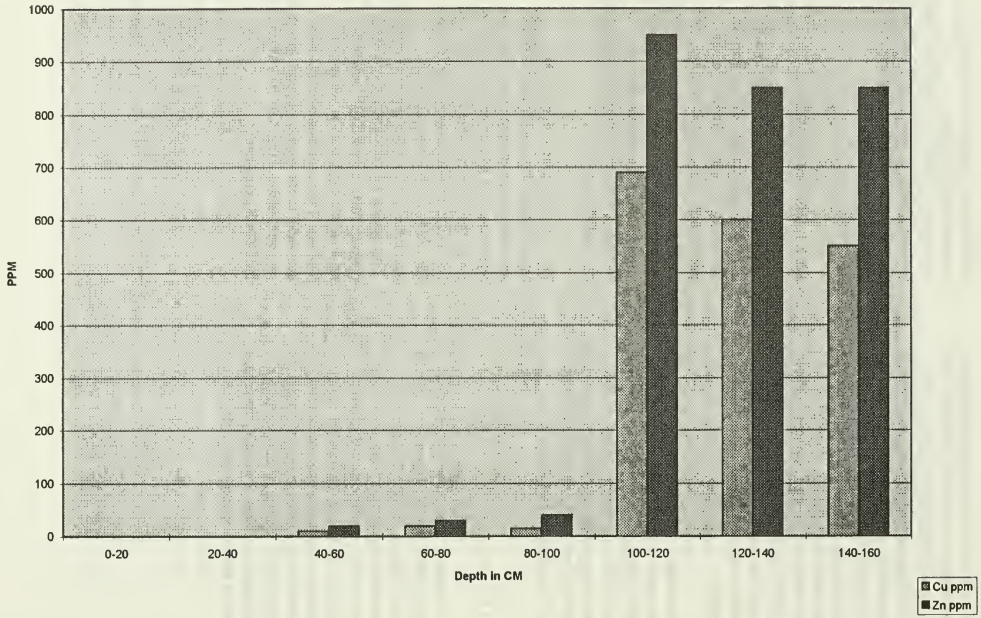


Figure 5-2. PAH Concentrations 11 Years After Placement: Interface at 80 to 100 Cm

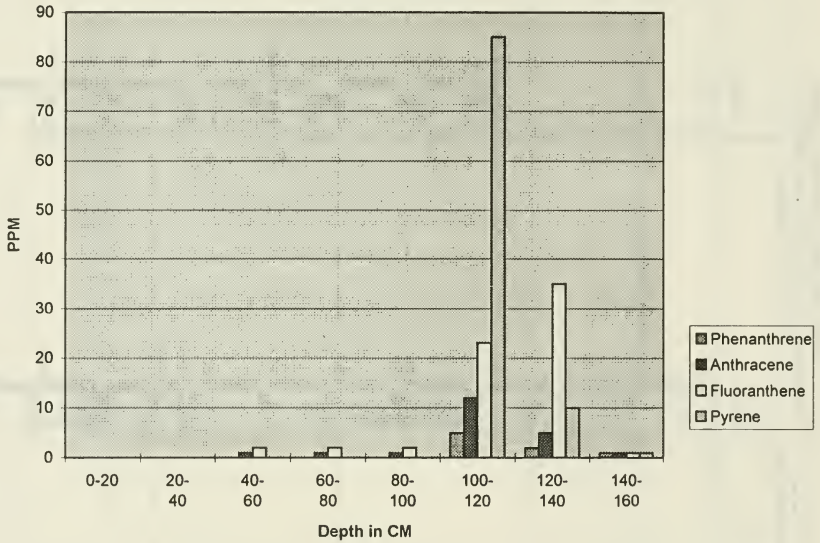


Figure 5-3
Boston Harbor Navigation Improvement Project
Schematic Dredging and Disposal Sequence
In-Channel Disposal

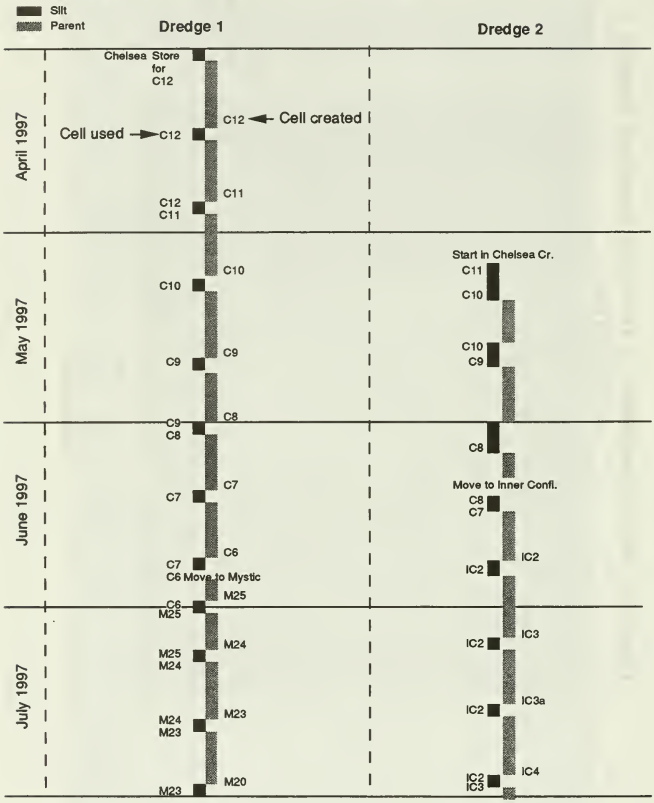


Figure 5-3 (cont'd)

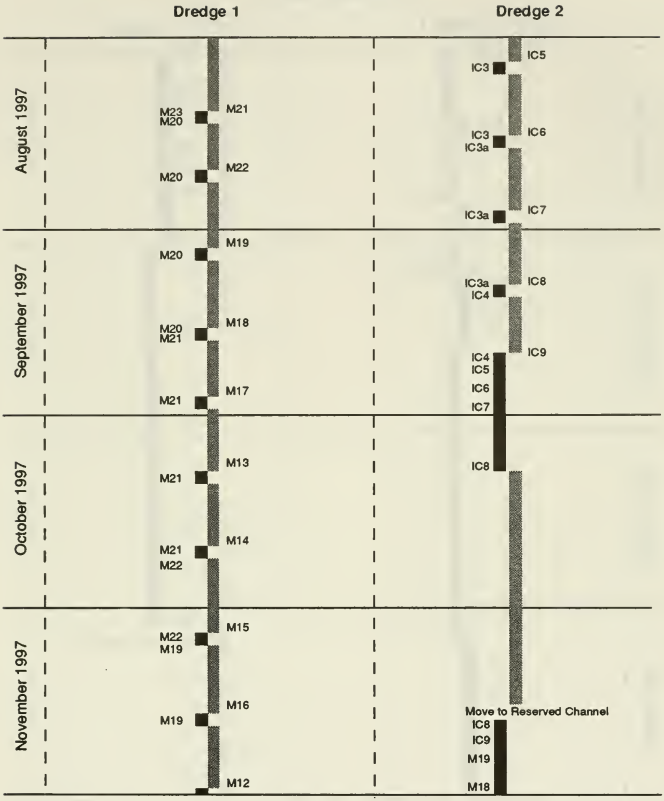


Figure 5-3 (cont'd)

Figure 5-3 (cont'd)

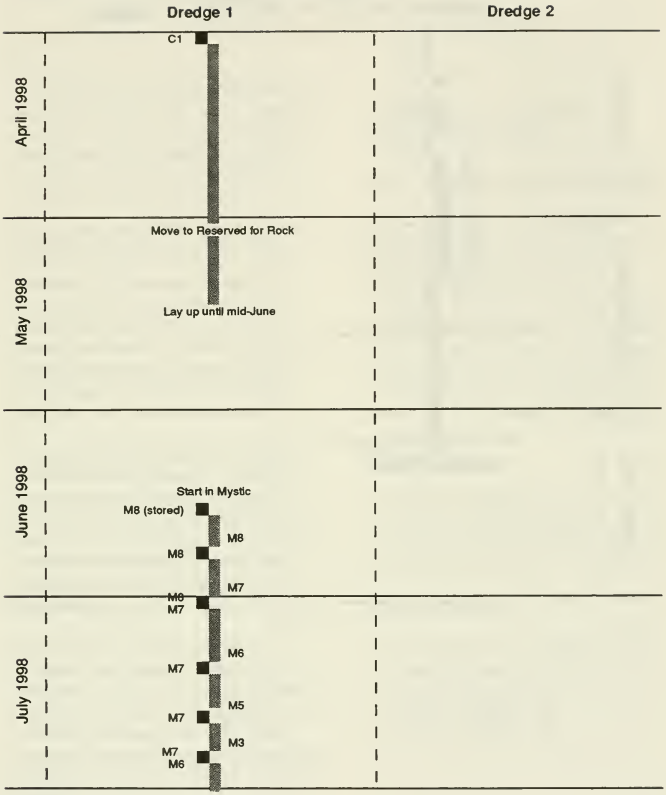
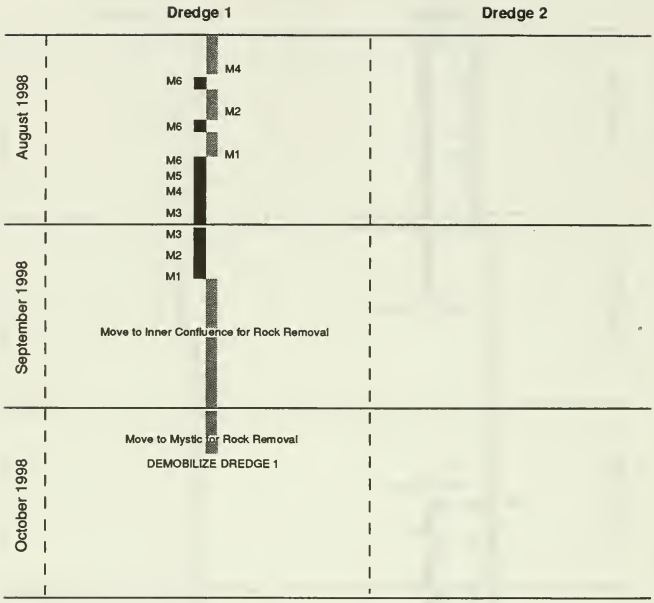


Figure 5-3 (cont'd)



Chapter Six: Summary of Project Impacts and Mitigation Opportunities

This chapter of the FEIR/S summarizes the primary, secondary and cumulative impacts imposed by the Boston Harbor Navigation Improvement Project (BHNIP) and identifies potential mitigation opportunities which would offset these impacts.

Primary impacts are those that include physical disruption or displacement (temporary or permanent) caused directly by the proposed dredging or material disposal activities. Primary impacts also include such issues as turbidity/suspended solids, sedimentation, dissolved oxygen (DO) reduction, chemical release, noise and odor.

Secondary impacts include indirect effects such as land-based changes, increases in truck traffic and changes in vessel traffic, if any. Cumulative impacts include all long term effects of the BHNIP, in association with future maintenance dredging, and reasonably foreseeable long-range material disposal issues.

This chapter also identifies potential mitigation opportunities for these impacts within the framework of federal and state regulations. Section 6.1 summarizes and quantifies the primary, secondary and cumulative impacts caused by the preferred alternative identified in Section 4.0 of this FEIR/S.

6.1 PRIMARY IMPACTS OF PREFERRED PROJECT

6.1.1 Direct Impacts to Resource Areas

The primary impacts associated with dredging include direct disturbance of bottom sediments in the areas to be dredged. The preferred project alternative, termed the Full Project (see Chapter Two), will remove contaminated silt on 320 acres within the Boston Inner Harbor representing approximately 21% of the Inner Harbor area. This acreage is made up of the following individual areas:

Federal Project

- Reserved Channel: 44 ac.
- Main Ship Channel: 18 ac.
- Mystic River/Inner Confluence: 134 ac.
- Chelsea Creek: 68 ac.

Project Beneficiaries

- Prolerized/Distrigas Terminals: 6 ac.
- Moran Terminal: 1.5 ac.
- Eastern Minerals Terminal: 1 ac.
- Gulf Oil Terminal: 7 ac
- Conley Terminal: 14 ac.

Non-Beneficiary Berths

- Revere Sugar Terminal: 1.5 ac.
- Mystic Piers Terminal: 3 ac.
- North Jetty Terminal: 3.5 ac.
- Army Base: 13 ac.
- Boston Edison Intake: 0.5 ac.
- Boston Edison Barge Berth: 0.5 ac.

Approximate total acreage of full project: 315.5 acres, rounded to 320 acres in this report.

The Full Project will remove about 1.1 million cy of silt, 1.7 million cy of parent material, and 88,000 cy of rock, all measured in place. Due to expansion during removal and handling, the corresponding bulked volumes required for disposal are approximately 1.4 million cy of silt, 2 million cy of parent material, and 132,000 cy of rock.

Based on chemical analyses and results presented in the DEIS/R, the parent material and rock is considered suitable for a variety of unconfined disposal options. As described in Chapter Three, several beneficial uses of this material are planned or under consideration. These include:

Parent Material

Open Water Containment Cap
Nearshore Containment Cap
Subbtidal/Intertidal Habitat Creation
Landfill Liner/Cap Closure Material

Rock

Fish Habitat Enhancement
Shoreline Protection
Containment Site Development
Upland Fill/Commercial Reuse
Armoring for Disposal Site

The disposal of the silt materials is a more complex issue. Based on the sediment analyses and results presented in the DEIR/S, the 1.4 million cy of silt generated by the Full Project is considered unsuitable for unconfined ocean disposal sites.

Chapter Four of the FEIR/S detailed the selection process for the preferred material disposal alternatives. In-channel disposal has been determined to be the LEDPA, and will handle the entire 1.4 million cy of material removed from within the dredging footprint based on design calculations performed by the Corps. The in-channel cells will occupy 116 acres.

While it is expected that in-channel disposal would provide sufficient capacity for all contaminated silts, excess capacity for contingency planning purposes, has been identified and evaluated as part of the FEIR/S in response to agency comments. As described in Chapter Four, Little Mystic Channel (LMC) could provide an additional 15 acres or 303,000 cy of confined capacity within the Mystic River Designated Port Area (DPA). This site also ranked fairly low in terms of severity of environmental impacts along with the other shoreline sites (see Table 4-6). It also rated, in general, moderately practicable in the practicability screening and was one of the least costly options (see Table 4-7).

In summary, the primary impact of the full project dredging and the in-channel

materials disposal would include the temporary displacement of benthic substrate over approximately 320 acres in a DPA. Should the LMC be required as a contingency site, it would impact an additional 15 acres of benthic habitat in a DPA.

As part of project planning, the project team conducted a functions and values assessment. As presented in Appendix K, this assessment has been presented as a "Principal Valuable Function Evaluation" (PVF). The purpose of the PVF is to provide a process to compare real pre-project functional conditions against effects caused by the BHNIP. Based on this comparison, conceptual mitigation considerations (if necessary) can be developed to offset anticipated impacts. The PVF describes significant resource conditions during the pre-project phase and the dredging and disposal phases. The resulting substrates over the in-channel disposal areas will consist of clean granular material as opposed to the present condition of contaminated silts. Given the current trend of improvement in Boston Harbor water quality, the disposal and sequestering of contaminated silts should help to provide cumulative benefits to the BHNIP project area.

6.1.2 Dredging Impacts

6.1.2.1 Water Quality/Sediment Quality

A mechanical bucket dredge will be used to excavate the substrate. Only a relatively small percentage of the dredged material becomes suspended in the water column when the appropriate equipment (i.e., an environmental bucket for the silts) is used. More of the material would be released during dredging operations if large debris prevents the dredge bucket from closing. To minimize this, the environmental bucket will be fitted with a sensor to alert the operator if the bucket fails to close. Suspended material resulting from the dredging project is principally restricted to the silt or clay fraction ($\leq$ .06 mm) with sand particles ($>$ .06mm) settling out immediately after suspension. Grain size analyses of 18 stations in Channels identify the substrate as 86.5% clays and silt, 11.2% as sand, and 2.3% rock.

The organic material associated with the silt and clay materials could depress ambient oxygen concentrations. However, the chemical oxygen demand for all 18 stations sampled averaged 80,509 ppm for surficial samples, a moderate value. The clean parent material (approximately 62% of the material to be dredged) would not exert an oxygen demand on the water column because this material does not contain substantial organic materials. Increased turbidity would reduce light penetration, lessening primary productivity and possibly reducing oxygen release from photosynthetic processes. Finally, upon settling, the suspended sediment load, both sand and silt/clay, could cover non-motile organisms adjacent to the dredging areas.

All of these effects are expected to be spatially and temporally limited to the immediate area of the dredge and length of the activity. The benthic community in the Inner Harbor is dominated by opportunistic/pioneer species indicative of a disturbed environment. Shellfish species

known to exist in the tributaries are not commercially harvested.

Monitoring results (EA, 1992) of dredging activities for the Central Artery/Third Harbor Tunnel Project (CA/T) indicated that Boston Harbor main ship channel dredge plume, generated during the tunnel trenching, was diffused and dispersed within 500 feet. Background (up-current) total suspended solids ranged from 8-20 mg/l and the plume (500-ft. down current) ranged from 8-34 mg/l. BHNIP would expect similar results. Additional modeling results are presented in Appendix F (ASA 1995). These results estimate that during dredging operations a small portion (~2%) of the dredged material is released into the water column (Tovalaro, 1984 cited in ENSR, 1991). This fraction accounts for both material suspended by the dredge (1.2%) and dredge scow overflow (0.8%). It is assumed that release from dredging operations will be continuous.

All of the effects associated with increased turbidity in Boston Harbor would occur in the immediate area of the dredge, be transported by currents, and settle rapidly. After completion of the dredging activity, these impacts will cease. The motile organisms should generally escape this downcurrent sedimentation by leaving or avoiding the area of activity. Sessile organisms will be impacted. However, sessile organisms inhabiting Boston Harbor are estuarine species that are tolerant of recurring turbidity stresses.

One of the functional characteristics of an estuarine system, such as Boston Harbor, is to serve as a nutrient retention area, increasing the productivity of its subcomponents. Nutrients are effectively "trapped" in the sediments where they are stored. This trapping and storage function also allows for the retention of pollutants in the same substrates, especially in fine grained sediment which have a larger surface area for pollutant adsorption. The physical removal of these sediments by dredging operations has the potential to release some of the sediment bound pollutants.

A review of the levels of sediment chemistry, the ambient water quality and the use of an environmental bucket or clamshell dredge, indicates that a low potential exists for substantial degradation of ambient water quality during dredging. After project completion, the benthic substrate of the Boston Harbor will be less contaminated in the dredged areas due to the removal of the surficial sediments which contain a majority of the contaminant load and placement of clean cover material, thus providing a beneficial effect.

6.1.2.2 Biological Resources

The primary impact of this project on biological resources will be the removal of benthic organisms inhabiting areas to be dredged. This impact could represent a low (29 organisms/m^2) to high (4,800 organisms/m^2) loss of benthic organisms, depending on the season and areas to be dredged. As described in Section 4.0, NAI conducted a fisheries, lobster and benthic survey within areas of the Harbor potentially affected by dredging and disposal activities. REMOTS data for the

in-channel Mystic and Chelsea River resulted in an organism sediment index of 3.0, indicating moderate habitat value. The dredging of the channel will cause a short term loss of benthic productivity that will be rapidly offset through faunal recolonization. This recolonization potential has been recently demonstrated by MWRA studies of Harbor areas disturbed by the 1992-93 winter storms. These areas were extensively recolonized by opportunistic species such as *Ampelisca* sp. (J. Kelly, pers. comm. 1993).

Fishery resources associated with the Mystic River, Chelsea Creek and Inner Confluence should be considered moderately significant. Representative lobster catch data for the three reaches within the dredging footprint is calculated as Catch Per Unit Effort (CPUE) as follows:

Mystic River:	0.2
Chelsea River:	0.2
Inner Confluence:	0.9

Mystic River and Inner Confluence catch data are dominated by sublegal sized ($\leq$ 83mm) males, whereas Chelsea River data is equally distributed by size (legal/sublegal) and sex.

Representative BHNIP finfish data, based on 20-minute trawls, in the same study areas, is also calculated as CPUE as follows:

Mystic River:	21.8
Chelsea River:	25.0
Inner Confluence:	13.59

The Mystic River catch was dominated by winter flounder, atlantic tomcod and scup. The Chelsea River catch was also dominated by winter flounder and atlantic tomcod. At the Inner Confluence, the dominant species was winter flounder. These findings are comparable with previous finfish surveys in the area (e.g. Haedrich and Haedrich 1974).

Chemical signals essential for anadromous fishery migrations could become masked by the dredging operation's suspension of sediments and associated chemicals. Dredging will be scheduled to avoid impacting critical spawning runs of those species.

Sediment suspension will also displace motile species that will attempt to avoid gill abrasion, lower DO levels, and reduced sensory opportunities for predation (masked odors and low visibility) in the dredging area. These would be all temporary and the effects would not have long term detrimental impacts.

Mortalities of fish and invertebrates are most likely to occur during the explosive fracturing and mechanical removal of approximately 88,000 cubic yards of bedrock. Fish kill zones depend on rock density, anticipated explosive size during a single blast, open water fish kill research, and physical characteristics of the Harbor. BHNIP fish density data (two seasons of fish trawls and gill net collections) indicate the average density in Boston Harbor is approximately 10 fish/m^2. If at any given time the fish were present in the water column directly over the blast and orientated sideways to it, the maximum moralities may range from 300 to 14,000

fish per blasting operation. High end mortalities would be unusual. Monitoring of blasting operations during the navigational improvement project in Portsmouth Harbor in New Hampshire did not indicate fish kills close to these maximum ranges. However, the monitoring results recorded only the fish seen floating at the surface. Even if the number of fish killed per blast are high, they are similar to the range of fish killed in a commercial fish trawl.

Species of marine mammals which may occur in tidal waters in the vicinity of the project area, include harbor seals *(Phoca vitulina)*, harbor porpoises *(Phocena phocena)*, and grampuses *(Grampus griseus)*. However, their presence in the Boston Harbor system is uncommon (Cortell, 1990). Since most of the dredging impacts will occur well within the Inner Harbor where marine mammals are uncommon, the project is not likely to cause adverse impacts to these species.

6.1.2.3 Threatened and Endangered Species

The intertidal and subtidal areas, including and adjacent to the Federal channel, are not known to provide habitat for any Federal threatened and/or endangered species, or State rare species. Coordination with the U.S. Fish and Wildlife Service, the National Marine Fisheries Service and the State Natural Heritage Program have confirmed the lack of any threatened, endangered, or rare species in the dredging area.

6.1.2.4 Historical and Archeological Resources

Boston Harbor has been subject to navigation improvement projects since the mid-nineteenth century. The channels and rivers in and around the Harbor have been deepened, widened, and straightened. This activity has severely limited the historic and archeological potential of the Harbor.

The dredging portion of BHNIP will not adversely affect sites of historic, architectural or archeological significance, as defined by the National Historic Preservation Act of 1966. The Massachusetts Historical Commission reviewed the deep-draft navigation improvement project, including the berthing areas, and determined that dredging the previously maintained channels and berthing areas will not have an adverse impact on any historical or archeological resources.

The Chelsea Street Bridge is considered to be eligible for the National Register of Historic Places, as it is the only Strauss heel-trunnion bascule bridge known to survive in the Commonwealth. Navigation improvement dredging is not expected to impact this bridge.

6.1.2.5 Noise and Odor

Dredging with a mechanical bucket will produce noise from the engines lifting and lowering the dredge bucket. The noise produced will be similar to other diesel engine equipment in the area. Many of the receptors in the three tributaries are businesses. Residential areas only exist

near the mouth of Chelsea Creek and near the Tobin Bridge. Noise may be greater during the warmer time of year when people are outside more frequently and windows are open. Although the dredges are expected to work 24 hours a day, the noise level will be masked by background noise from nearby transportation activity. Noise generated by this project should not be substantially different from other Harbor baseline noise levels.

In addition to the noise produced during the dredging operation, odor from dredged material placed on barges may occur. The odor impact, if any, would depend on the time of year and the direction of the wind. The number of barges that would be filled range from two to four per day based on the current dredging schedule (see Figure 5-3). Therefore the potential impact would be continuous while dredging the silt. Perception of odor would be minimal during the cold months of the year. This is due to the fact that more human activity would occur indoors and cold temperatures could keep the odor-causing bacteria count low. Generally, the dredging activity will be far enough away from population concentrations that mixing with ambient air is expected to be sufficient to dilute increased odors.

6.1.3 Disposal Impacts

6.1.3.1 Water Quality/Sediment Quality

Water quality modeling results (Appendix F) conclude that under continuous loading for the in-channel disposal option no constituents were found to exceed chronic water quality criteria, if material were released up to 6,000 cy/day. Instantaneous releases did not indicate any exceedence of chronic water quality criteria. It is important to note that chronic water quality criteria are the most stringent (very low levels) measure and much more stringent than the legally applicable state water quality standards.

6.1.3.2 Biological Resources

Downdrift harbor fauna should be tolerant to stresses associated with fluctuating turbidity levels and DO reduction. Given Boston Harbor hydrography, the mixing zone extends (based on TSS) over the following areas for each of the in-channel disposal sites:

Mystic River:	12.4 ac.
Chelsea Creek:	30.0 ac.
Inner Confluence:	14.7 ac.

Most of the episodic effects on biological resources will be triggered by the dredging itself. By locating the material disposal locations within the footprint of dredging limits the stresses associated with disposal.

6.1.3.3 Threatened and Endangered Species

There are no impacts anticipated, since the Federal channel and berthing areas are not known to provide habitat for any Federal threatened and/or endangered species, or any State rare species.

6.1.3.4 Historical and Archeological Resources

Historical and archeological resources are not anticipated to be impacted based on coordination with the Massachusetts Historical Commission and the Board of Underwater Archeology.

6.1.3.5 Noise and Odors

Impacts regarding noise and odors would be similar to, and part of, the actual dredging operation. Therefore noise and odors generated by the proposed material disposal operations, should not be perceivable beyond the actual dredging operations or the ambient air conditions. Noise and odor impacts may become more of an issue if excess capacity is needed in the LMC. Disposal and site grading at the LMC would be near to a housing development. Odors may be more noticeable, not only because of the proximity to sensitive receptors, but because the site will be graded to intertidal habitat, exposing the muds at low tide.

Odor controls, whether chemically applied treatments or operational controls such as observing wind direction in the disposal area, would be employed should the LMC site be needed. However, as stated earlier, the in-channel option is expected to provide sufficient capacity for the BHNIP silts.

6.2 SECONDARY IMPACTS

Secondary impacts consist of those affecting land-side issues, Harbor traffic and other socio-economic effects. The following subsections consider the identifiable secondary impacts of the preferred alternative.

6.2.1. Vessel Traffic

The BHNIP will not dramatically change operations in the Port of Boston. Vessel traffic is not expected to increase in number significantly. The current mix of vessel traffic will continue to include large container ships, barges and tankers. Some commentors expressed concern that the BHNIP will attract more ships thereby creating secondary impacts to marine mammals, ranging from disturbing normal behavior patterns to mortality from ship collisions. There are in place, Coast Guard regulations that are designed to deter interference with marine mammals in U.S. waters. The BHNIP is not designed to attract a vast array of new and larger ships. The Port geometrics, and service infrastructure, limit the eventual growth of the Port. Therefore, vessel traffic attributable to the BHNIP is not likely to have secondary impacts on navigation interests or marine mammals.

6.2.2 Terminal Improvements

The BHNIP will not dramatically change operations in the Port of Boston. Vessel traffic will continue to include a mix of large container ships, barges and tankers. The volume of cargo will not change noticeably as a result of dredging, since cargo volume depends on more than channel depth. Massport continues to upgrade its container handling facilities to

provide "state of the art" off-loading and storage at Moran and Conley Terminals. Therefore dredging need not trigger additional landside improvements at these terminals.

6.2.3 Roadway Improvements

Inland transportation improvements to serve the Port of Boston have long been the subject of planning and investment. The Seaport Access system, which is part of the Central Artery/Tunnel Project will result in more direct and convenient connections for trucks between port terminals and the regional highway network. At the same time, through State and Massport effort, infrastructure changes to accommodate double-stacked trains are being promoted. This latter effort is separate from the dredging project. The BHNIP will not alter these efforts in any way.

6.2.4 Growth of Fort Devens

One of the comments on the DEIR concerned impacts of the BHNIP on Fort Devens and the surrounding area. The concern related to environmental impacts of increased activity at Fort Devens because of additional cargo volumes being handled at the "inland port". As stated heretofore, the BHNIP, alone, will not increase cargo volumes coming through the Port of Boston. Further, Fort Devens will not change significantly as an "inland port" without major investment in the railroad infrastructure serving the port. Any project to improve rail infrastructure would be separate and distinct from the BHNIP. In 1994, 3% of containers handled in the Port of Boston were moved by rail. Of those containers, less than one third moved by rail between Moran Terminal and Ayer (Fort Devens) or beyond, with the rest going through the "inland port" facility at Fort Devens represented only 1% of the total container trade in the port of Boston. It is unlikely that this situation will change with the BHNIP. The rail route via Ayer is convenient for export cargo from New England and Canada, which represents only a small portion of the total cargo handled by the Port.

The region's imports substantially exceed the export cargo reflecting the nature of industry in the area. The New England textile and shoe industries, which traditionally exported high volume cargo through the Port, have given way to industries producing low volume, high value cargo which is generally shipped by air. The current export/import balance is expected to continue in the future regardless of the impact of dredging. Growth at Fort Devens will not be materially affected by import cargoes being carried by rail from Moran Terminal.

6.3 CUMULATIVE IMPACTS

Cumulative impacts include all long term maintenance requirements of the BHNIP in association with reasonably foreseeable long-ranged material disposal issues. These impacts also consider other actions in the Boston Harbor area that may have

an impact on, or be impacted by, the project.

6.3.1 Maintenance Dredging

Currently, estimates indicate that BHNIP will need to dredge and dispose of 4.4 million cy of material in the 50-year project life scenario to maintain the ship channel.

The selection of the disposal site for future maintenance dredging must reexamine the environmental and practicability criteria discussed in Chapter Four. Factors such as sediment characteristics and volume of the dredging project will be critical in determining the suitability of the disposal sites. Sites that were identified in this review as having lengthy permitting needs, but were otherwise reasonable, would also be reviewed carefully. The disposal site for future maintenance will be determined based on the appropriate environmental regulations and technical evaluations at that time. The New England Division Corps recommends, and will participate with the Commonwealth, in conducting an overall regional dredged material management plan for future maintenance of all Massachusetts Bay's harbors.

6.3.2 Relationship to Other Projects

During construction of this project, additional barge traffic will occur in the shipping channels and at the open water disposal sites. Barge traffic from the BHNIP is not anticipated to interfere with barge traffic from the Central Artery/Third Harbor Tunnel (CA/T) project. Barge traffic to Spectacle Island is anticipated to be complete by the end of 1998. Barge traffic for the CA/T project will leave from Subaru Pier, north of Reserved Channel, during the summertime, May thru September. Additional small barge traffic will begin next summer in 1996 to transport material from the Fort Point crossing area. BHNIP activities will not be coincident with this work.

The MBDS is not receiving any more material from the CA/T project. Approximately 470,000 cubic yards of material from the CA/T project was disposed at the MBDS. No material was disposed at this disposal site from the Massachusetts Water Resources Authority (MWRA) project in Boston Harbor (the other large project in Boston Harbor). Other small dredging projects in the Massachusetts Bay area may dispose of materials at the MBDS. The draft and final EISs for the MBDS site designation discuss the cumulative impacts from disposal at the MBDS. However, because of the current designation restrictions to the MBDS, the likelihood of many projects being accepted for disposal there is slight.

Disposal of clean parent material at the MBDS is not expected to interfere with the monitoring efforts of the outfall pipe for the MWRA project. About 95 to 97% of the parent material will be deposited within the MBDS. Any suspended material that may leave the disposal site will be mixed and diluted with other suspended solids in Massachusetts Bay.

Beneficial cumulative impacts are expected with the dredging of silt material from the navigation improvement project. Silt

material will be removed from the navigation channel and disposed in-channel and capped with coarse grained material which will sequester the contaminants. This will isolate the silt material, leave clean material in place, and will substantially increase the volume of clean substrate in the Inner Harbor. At the same time, the MWRA is controlling sludge and CSO's disposal into the harbor, and will have a new sewage treatment plant in operation. This will reduce the amount of contaminants released to the Harbor. The clean substrate in the Inner-Harbor and the reduced level of contaminants entering Boston Harbor will have an overall cumulative benefit.

6.3.3 Irreversible and Irretrievable Commitment of Resources

Construction of this project will result in the use of diesel engines on dredges used to remove material from the navigation channels and berthing areas, and to dispose of the material. Diesel fuel, which is an irreversible and irretrievable resource, will be used to operate this equipment. A minor temporary increase in air pollutants will occur as a result of this action.

In-channel disposal of silt material will eliminate the use of this area for future disposal of maintenance material. The contractor will be directed to dig as deeply as possible in the navigation channel to increase storage capacity. This will maximize the use of in-channel disposal and the use of parent material for beneficial use.

Disposal of clean parent material will reduce the capacity of MBDS by an incremental amount. The capacity of MBDS will be reduced by approximately two million cy (or less, if used beneficially). Although this is a large amount of dredged material, the MBDS will still have many more years of useful capacity.

6.4 MITIGATION FOR DREDGING AND DISPOSAL IMPACTS

Based on the preceding summary, several options for mitigating unavoidable impacts are described in this section. Critical to the understanding of mitigation planning is the regulatory framework that provides the underpinning for developing mitigation plans that not only address a specific impact but create long-term value to the impacted areas. This regulatory framework consists of local, state and federal interests.

An overriding principle is establishing mitigation concepts is the Council on Environmental Quality (CEQ) protocol for establishing and prioritizing mitigation measures incorporated into the Clean Water Act, Section 404 (b)(1) Guidelines, and the EPA/Corps Memorandum of Agreement on their implementation. The overall principals are:

- The avoiding of an impact altogether by not taking a certain action or part of an action;

- The minimizing of impacts by limiting the degree or magnitude of the action and its implementation;

- The rectifying of the impact by repairing, rehabilitating, or restoring the affected environment;

- The reducing or eliminating of the impact over time by preservation and maintenance operations during the life of the action; and

- The compensating for the impact by replacing or providing substitute resources or environments.

The following sections describe how the BHNIP complies with this hierarchy from project design through post-construction monitoring.

In addition to complying with specific conditions or policies as required by regulatory agencies, the BHNIP has incorporated design and operational mitigation actions to offset any adverse effects generated by the project. These include:

1. Capping with sand, with rock armoring in high-scour areas

2. Scheduling of dredging and disposal to fit environmental windows and to meet water criteria

3. Coordination with the U.S. Coast Guard to avoid interference between BHNIP activities and commercial traffic

4. Scheduling to avoid peak recreational Harbor usage (4th of July, other holidays)

5. Identification of significant structural features (bridge abutments, utility lines, bulkheads, moorings, buoys, etc.)

6. Dredging performance standards to meet environmental and permitting conditions as well as design controls

7. Use of environmental bucket to trap contaminated sediments during dredging and outfitting it with a sensor to detect closure problems due to debris

8. Use of silt curtains during disposal

9. Employment of fish deterrence systems during blasting

10. Requirement for contractor to provide an incident response plan to cover spills of dredged material, fuel, and machinery oil

11. Trash and debris management on separate scows with agreements to dispose of material in landfills

12. Contingency plans for reasonably foreseeable equipment failures, weather conditions, encounters with buried structures, and permit limit exceedences

The following paragraphs focus on resource mitigation requirements in terms of the CEQ mitigation protocol.

6.4.1 Avoidance

As described in Chapter Two, the Full Project alternative is the preferred project alternative to be implemented. The dredging footprint is unavoidable, but as described earlier, any disruption or displacement of benthic organisms is temporary.

As described in Chapter Four, the BHNIP proposes to dispose of the bulked volume of 1.4 million cy of contaminated silt using two LEDPA strategies. The first will dispose and sequester the silts in place by overdredging 54 cells into the underlying clean parent material. These cells will be located within the existing dredge footprint, avoiding additional spatial requirements.

Second, the clean parent material (clay) and rock, not expended in beneficial uses (e.g. landfill liner or capping material), will be disposed at a previously approved and permitted disposal area (MBDS). No BHNIP silt or parent material disposal will be conducted in significant offshore marine fisheries resources such as the Meisburger sites.

6.4.2 Minimization

When avoidance is not feasible, the BHNIP will be designed to minimize adverse effects to sensitive resources and interests. Minimization includes limiting the spatial extent of the proposed dredging footprint to meet the size and draft of the largest vessels transiting the proposed channel, thereby minimizing the volume of the dredge material required for disposal. Limiting project activities to areas within DPA's, minimizes impacts to areas designated to support water dependent industrial and maritime uses. Other elements minimizing impacts include the design and operational measures summarized above under Section 6.4.

6.4.3 Rectification

The BHNIP will be prepared to rectify any unexpected impacts, or impacts caused by temporary project elements (e.g. staging areas, piers, piles, etc.) after they have been used and removed from service. These activities are more fully described in the mobilization and demobilization sections of Chapter Five.

6.4.4 Reduction or Elimination

The use of in-channel cells to dispose and sequester contaminated materials reduces or eliminates future adverse effects of this material's continued exposure to aquatic resources and keeps the material close to its source and therefore does not "export" contamination to more pristine areas. This is also the case should use of LMC be required for contingency capacity. However, this contingency option would require compensation for lost benthic habitat.

6.4.5 Compensation

The mitigation protocol hierarchy places compensation for resource impacts as the lowest prioritized option. This means that avoidance, minimization, rectification or reduction of impacts should be exhausted first.

To establish compensation as a permittable mitigation option, the BHNIP must prove that the preceding mitigation alternatives (avoidance, minimization, rectification and reduction/elimination) are not completely practical or feasible to address all project

impacts. Once established as a suitable mitigation option, compensation must be based on offsetting any adverse effects to protectable resources.

In an attempt to define the requirements for resource mitigation, the project team conducted a preliminary identification of potential sites and projects for mitigation consideration. Based on the PVF (Appendix K), the BHNIP should not be required to provide compensatory mitigation. These findings are summarized below:

6.4.5.1 Summary of PVF Conditions at the In-Channel Sites

Benthic Habitat: Pre-project conditions include an opportunistic and pioneer community of low abundance, over the entire 116 acres that will contain the 54 disposal cells. The disposal footprint is less than the 320 acres of dredging impact primarily since the Reserved Channel and its entrance from the Main Ship Channel, would not contain disposal cells. The project will establish 152± acres of clean granular material substrate and 50± acres of clean hard rock substrate. These project conditions will provide a more varied habitat (soft and hard substrates), and should support a more abundant and varied community (burrowing and epibenthic).

Shellfish/Lobster Habitat: Pre-project conditions include the area being mapped by EOEA (1978) as shellfish habitat, and yielded moderate CPUE catch data for lobster at 1.4 per trap day. The project will establish 152± acres of clean granular material substrate and 50± acres of clean hard rock substrate. Project effects should not alter EOEA's mapping of the shellfish resource. These conditions should enhance existing shellfish habitat, and attract hard substrate species (e.g. blue mussels); and improve existing feeding, resting, refuge and breeding habitat for lobster.

Finfish Habitat: Pre-project conditions indicate a low abundance of demersal and pelagic species typically found in the Boston Harbor area. An anadromous fish run exists through the Inner Confluence and Lower Mystic River portion of the in-channel area. Project activities may pose short-termed disruptions to existing finfish activities, but these should be limited in terms of time and location of activity and can be avoided by observing the environmental "window". The clean granular substrates should enhance finfish habitat following completion of the project.

Production Export: Production export does not exist in either the Pre-project evaluation scenarios. Parts of the 50± acres of rock cap may provide attachment for species, and any attached aquatic vegetation should provide some additional, but limited production export function, in the post project condition.

Sediment/Shoreline Stabilization: Sediment/Shoreline Stabilization occurs, and will continue to occur, in each of the evaluation scenarios. Areal bulkheads and wharves will not be adversely impacted by the project. Removal of contaminated silt and replacing the surficial layer with clean sand will also enhance this function.

Wildlife Habitat: Currently feeding habitat for waterfowl, dabbling and diving birds, and some roosting sites exist. Project activities may pose short-termed disruptions to existing wildlife activities, but these should be limited in terms of time and location. No enhancement of habitat conditions is anticipated.

6.4.5.2 Summary of PVF Conditions at LMC

As stated earlier, the project team has evaluated other disposal alternatives for capacity contingency purposes. The environmental and practicability screening described in Chapter Four indicates that Little Mystic Channel is the LEDPA for a contingency site. The following is a PVF evaluation for the LMC that is designed to help identify required mitigation actions should this site be required for excess capacity.

Benthic Habitat: Pre-project conditions include an opportunistic and pioneer subtidal community of low abundance, over the entire 15 acres. The project will change the entire site from contaminated subtidal substrate to clean intertidal substrate, and therefore should provide an opportunity for a more diverse and abundant benthic community structure.

Shellfish/Lobster Habitat: Pre-project conditions include the area being mapped by EOEA (1978) as shellfish habitat, and yielded moderate CPUE catch data for lobster at 1.1 per trap day. The project will establish up to 15 acres of clean soft granular material intertidal substrate. These conditions should enhance existing shellfish habitat for soft-shell clams and ribbed mussels, but will eliminate transient lobster habitat.

Finfish Habitat: Pre-project conditions indicate a low abundance of demersal and pelagic species typically found in the Boston Harbor area. The site is also adjacent to an anadromous fish run in the Lower Mystic River. Project activities convert the site from transient demersal and pelagic habitat to an intertidal fish habitat.

Production Export: The establishment of clean intertidal substrate should attract both rooted and attached aquatic vegetation, and should provide some additional, but limited, production export function.

Sediment/Shoreline Stabilization: The proposed intertidal conditions will continue to function as buffeting from wave and current energy.

Wildlife Habitat: Currently, feeding habitat for waterfowl, dabbling and diving birds, and some roosting sites, exist. Project activities may pose short-termed disruptions to existing wildlife activities, but these should be limited in terms of time and location. Proposed intertidal conditions should provide additional feeding habitat for wading and shorebirds. However, wildlife usage is highly dependent on areal land uses, and in this case, urban and maritime, may limit the amount of achievable enhancement.

Endangered Species Habitat: Endangered species habitat does not occur at this site.

6.4.6 Resource Enhancement Concepts

Given the findings provided in the PVF, the BHNIP should pose only limited negative temporary effects to either the in-channel or Little Mystic Channel PVF's. In fact, the project as designed appears to provide significant on-site enhancement of project specific PVF's primarily through the sequestering of contaminated sediments and placement of clean substrate. Given these findings, no compensatory resource mitigation should be required under either federal or state wetland regulations for the in-channel option. Resource compensation may be required at the LMC for converting subtidal to intertidal habitat. Should this contingency site be required, consultation with the appropriate resource agencies will identify compensatory mitigation options. However, for the preferred alternative, no compensatory mitigation is required.

As local sponsor, Massport is willing to work with state resource agencies to identify resource enhancement opportunities in the Harbor Area. As examples, these can include supporting the development of an "urban fishing park" through rehabilitation of water access structures to enhance public use and access to functional, recreational fishing areas. In addition, Massport is willing to work with appropriate agencies to increase the number of vessel sewage pump-out facilities in the Harbor Area.

6.4.7 Summary

Massport will continue to explore resource enhancement options, if required, during the permitting of the project. The project as designed contains numerous operational mitigative measures. The preferred disposal alternatives meets the CEQ protocol for establishing and prioritizing mitigation measures, and is the least environmentally damaging alternative. The Draft Section 61 finding included as Chapter Eight, summarizes the mitigation actions proposed for the project and for meeting permit requirements identified in the next Chapter.

The purpose of this section is to clearly outline a non-exhaustive list of anticipated permitting issues relative to mitigation, which will require project compliance; and the means by which the BHNIP currently complies, or how the BHNIP proposes to comply with all relevant jurisdictional requirements.

7.1 LOCAL JURISDICTION

Dredging and dredge material disposal activities will occur in three separate municipalities, which include the Cities of Boston, Everett and Chelsea. In telephone conversations with each city's conservation commission (ConComs), on January 23 and 31, 1995, it was reported that none of these cities have local wetland protection bylaws. Therefore they have no apparent mitigation jurisdiction beyond that which is designated to them through state law and regulation.

7.2 STATE JURISDICTION

The proposed dredging and disposal plan occur within Designated Port Areas (DPA's). This is significant to the application of the Chapter 91, and coastal zone management and state wetland programs having jurisdiction over this project. The DPA's are illustrated on Figure 7-1 and 7-2.

7.2.1 Massachusetts Waterways Licensing Program (MGL c.91 and 310 CMR 9.00)

The Massachusetts Waterways Licensing Program, dated October 4, 1990 (c. 91) defines DPA's as follows:

> "Those areas designated in 310 CMR 9.24 (2) and (3) of the Waterways Regulations promulgated in 1978 (MGL c. 91 and 310 CMR 9.00); and are almost completely developed areas where few or no natural land forms or vegetation remain. They tend to be paved, bulkheaded, and used for heavy industry so that they have virtually no significance to the interests of the Act, except for land under the ocean." (A Guide to the Coastal Wetlands Regulations of the Massachusetts Protection Act G.L. 131, s.40, Cooperative Extension Service, UMASS, Amherst, 1978, pg. 13)

As currently set forth in 310 CMR 9.04, the following geographic areas are subject to jurisdiction, relative to the BHNIP:

- all waterways, including flowed tidelands; and
- all filled tidelands, except for landlocked tidelands.

C. 91 also allows that the Massachusetts Port Authority (Massport) "in accordance with its Enabling Act, St. 1956 c. 465,

may undertake certain activities within certain geographic areas without written authorization (emphasis added) in the form of a license or permit from the Massachusetts Department of Environmental Protection (MADEP) 310 CMR 9.03 (3). Except as provided in 310 CMR 9.03 (3)(b), Massport shall obtain a license or permit pursuant to c. 91 for any project consisting entirely of (emphasis added) uses other than water-dependent industrial uses." Privately owned berths to be dredged in the BHNIP may require individual compliance.

While Massport may be exempt from a requirement for written authorization, any project that includes dredging or dredged material disposal must comply with the following requirements relative to DPA's (310 CMR 9.40):

1) The design and timing of dredged material disposal activity shall be such as to avoid interference with anadromous/catadromous fish runs. At a minimum, no such activity shall occur in such areas between March 15th and June 15th of any year, except upon a determination by the Division of Marine Fisheries (MADMF) that such an activity will not obstruct or hinder the passage of fish.

2) The design and timing of dredging and dredged material disposal activity shall be such as to minimize adverse impacts on shellfish beds, fishery resource areas, and submerged aquatic vegetation. MADEP will consult with the MADFM regarding the assessment of such impacts.

Additional requirements for all dredging and dredge material disposal projects (310 CMR 9.36 (3-5)) include requirements for operations issues associated with dredging and disposal. These are considered in the Dredge Management Plan.

Finally, all projects under c. 91 jurisdiction must conform with all relevant federal, state and local environmental protection standards; municipal zoning and harbor plans; and must meet all standards to preserve water related public rights (310 CMR 9.33 through 9.35 et seq). Massport, and the Corps are not subject to zoning requirements. Individual, private berth owners, however, must comply.

7.2.2 Massachusetts Wetland Protection Act (MGL c. 131, § 40 and 310 CMR 10.00)

The Massachusetts Wetlands Protection Act and its implementing regulations describe the performance standards within DPA's.

Land under the ocean in DPA's plays a role in flood control, storm damage prevention, and the protection of marine fisheries. The additional functions in DPA's include support for coastal engineering structures, such as bulkheads, seawalls, revetments, and solid fill piers. This support contributes to its value for flood control and storm damage prevention.

Since land under the ocean is considered the only resource impacted by the BHNIP, this limits protectable interests to storm damage prevention and flood control, and protection of marine fisheries. Activities which could affect these interests include:

- Dredging;
- Construction of Seawalls;
- Dredge Material Disposal;
- Bulkheads and Revetments; and
- Point Discharges;
- Piers, Docks, Wharves, Floats,
- Fill; Piles and Dolphins.

These activities are typically acceptable in DPA's. Table 7-1 lists those conditions which must be met, in order to obtain an Order of Conditions for these activities in DPA's.

Revisions to dredge material disposal compliance requirements are currently proposed by the MADEP, Division of Water Pollution Control (DWPC) in water quality certification regulations (314 CMR 9.07) effective March 1, 1995. Table 7-2 is a reproduction of Table III from 314 CMR 9.07. These revised regulations more clearly outline specific disposal opportunities for the dredge material.

The in-channel disposal option, with clean granular capping, is most closely represented by confined (bulk-headed) in-Harbor disposal and therefore may comply with these requirements. As stated earlier in this FEIR, portion of the BHNIP dredge material disposal program would be to dispose of up to 303,000 cy of silt material at LMC, as a contingency should the projected volume capacity of the in-channel cells be inadequate to handle the entire volume. This disposal alternative will displace up to 15 acres of subtidal estuarine resource. Chapter Four of the FEIR/S describes the biological/ecological resource quality as being degraded. Should the use of this site be required to provide additional disposal area for the silts, these materials will be completely sequestered from the remaining aquatic environment. As shown in Table 7-2, this activity may also be approvable with effluent control.

7.2.3 MCZM Jurisdictional Review and Policies Relative to DPA's (MGL c. 6a, § 2-7 and 301 CMR 20.00)

301 CMR 20.05 sets forth the regulatory and non regulatory policies adopted for the MCZM project review program. Of special significance to the BHNIP are regulatory policies 1, 4, 5 and 7 and non-regulatory policy 7.

Regulatory policy 1 is concerned with protecting ". . . ecologically significant resource areas (salt marshes, shellfish beds, dunes, barrier beaches and salt ponds) for their contribution to maritime productivity and value as natural habitats and storm buffers."

Regulatory policy 4 conditions construction in water bodies ". . . to minimize interference with water circulation and sediment transport and to preserve water quality and marine productivity . . ."

Regulatory policy 5 extends this concern to ensure that ". . . dredging and disposal of dredged material minimizes adverse effects on water quality, physical processes, marine productivity and public health."

Regulatory policy 7 encourages ". . . the location of maritime commerce and development in segments of urban waterfronts designated as port areas.

Within these areas, prevent the exclusion of maritime dependent industrial uses that require the use of lands subject to tidelands licenses."

Non-Regulatory policy 7 encourages ". . expansion of water-dependent uses in DPA's and developed harbors, redevelopment of urban waterfronts and expansion of visual access."

The intent of these policies is to ensure that special physical and operational requirements of uses dependent on access to navigable channels are recognized while not compromising environmental resources. In addition, assigning priority to the use of DPA's for maritime dependent industrial development encourages such uses to locate there. These policies, therefore, minimize the need for dredging new deepwater channels elsewhere and maximize the use of prior public investments made in existing port facilities.

According to MCZM policy statement and guidance (310 CMR 20.99) all proposals for maritime-dependent industrial developments in DPA'S will be encouraged by MCZM and will be facilitated as much as possible by the EOEA agencies, unless the proposed use will seriously conflict with, or preempt other existing maritime-dependent industrial uses in that port, or other ports.

The BHNIP dredging and disposal plans appear consistent with their CZM policies.

7.2.4 Massachusetts Division of Water Pollution Control, Clean Water Act 401 Certification (314 CMR 9.00)

Under Section 401 of the federal Clean Water Act, an applicant proposing any activity requiring a federal permit that will result in a discharge to waters or wetlands subject to federal jurisdiction is required to obtain a state certification that the project will comply with state water quality standards. For purposes of Section 401, "discharges" include the filling of "waters of the United States" requiring a Section 404 permit under the Clean Water Act and discharges associates with dredging and dredged material disposal under Sections 9 and 10 of the Rivers and Harbors Act.

A 401 Water Quality Certification issued by the Department of Environmental Protection is a determination that the proposed activity will not violate the Massachusetts Surface Water Quality Standards, as implemented by 314 CMR 9.00. The Department may, during the course of its review of any project, attach conditions to ensure that water quality is protected, environmental damage is minimized, and all other applicable state requirements are satisfied. This certification is necessary for the federal permit to be valid, and any certification conditions become conditions of the federal permit.

The regulations also contain criteria for dredging and dredged material disposal. In addition to Section 404 permits for the discharge of dredged and fill material in wetlands, the Department must also certify permits issued by the Corps of Engineers to implement Sections 9 and 10 of the Rivers and Harbors Act of 1899 for structures or work in or affecting the course, location, condition or capacity of navigable waters of the United States. Under Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972, the Corps of Engineers regulates the transportation of dredged material by

vessel or other vehicle for the purpose of dumping it in ocean waters at designated dumping sites. These activities also may require a Section 401 Water Quality Certification from the Department. Section 307(c) of the Coastal Zone Management Act of 1972 requires applicants to obtain a certification or waiver that the activity complies with the state's coastal zone management program for activities affecting a state's coastal zone.

The water quality certification application must demonstrate that the proposed action is the preferred, practicable alternative. Chapter Four provides a step-wise screening approach to determine that the in-channel option is the least environmentally damaging alternative. The application must also demonstrate that all practicable steps have been taken which will minimize potential adverse impacts.

Chapter Six presents a summary of design, operational, and resource enhancement options that are made part of the BHNIP to address these concerns. In addition a fate and transport model of all aquatic alternatives was prepared (see Appendix F) to compare impacts of dredging and disposal to stringent chronic water quality criteria. The model indicates that, with appropriate operational scheduling, the in-channel alternatives meets the most stringent chronic water quality criteria.

Based on the technical information presented in the Draft and Final EIR/S, the BHNIP preferred alternative will comply with the requirements for a water quality certification.

7.3 FEDERAL JURISDICTION

Permits will be required for various Massport activities and structures within Corps jurisdiction, including dredging of berth areas. The Corps administers Section 404 of the Clean Water Act and Section 10 of the River and Harbors Act of 1899 which regulates structures and work in navigable waters.

All permit applications will be evaluated by the Corps based on a public interest review of the probable impacts of the proposed activity and its use. 404(b)(1) Guidelines compliance must be demonstrated through "factual determination" before permit issuance. These Guidelines prohibit discharges into aquatic areas where less environmentally damaging practicable alternatives exist. Table 7-3 contains the factual determinations for all short-listed sites. These factual determinations are based on the findings of the current BHNIP environmental database and the PVF described in Chapter Six.

Once compliance is clearly demonstrated by the applicant, the Corps can proceed with an evaluation of public interest. The Corps considers the following criteria, among others in evaluating an application: the need for the project; practicability of reasonable alternatives and the beneficial and or detrimental effects.

The Federal portion of the project also requires compliance with the 404(b)(1) guidelines. This FEIR/S is intended to serve both the Massport berth dredging project and the Federal portion of the BHNIP.

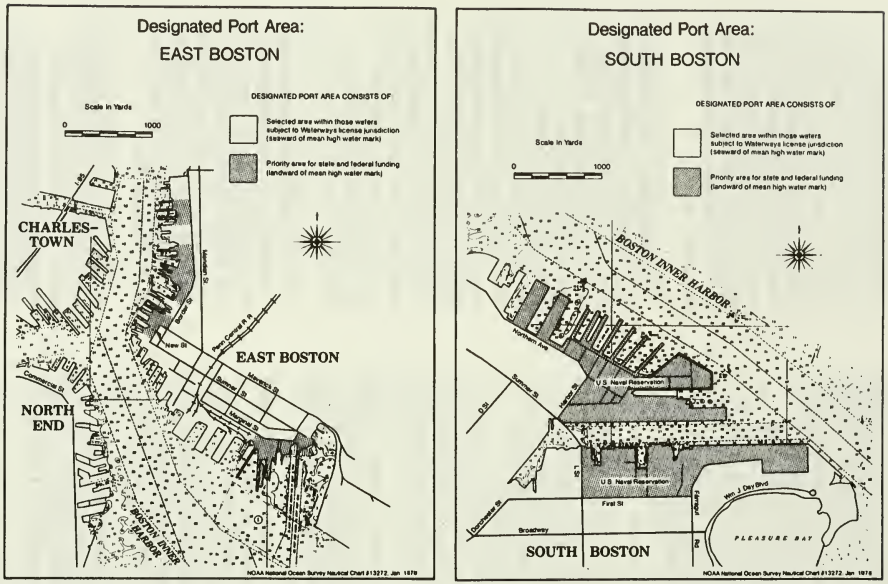

Designated Port Area:
EAST BOSTON
Scale in Yards
0
1000
DESIGNATED PORT AREA CONSISTS OF
Selected area within those waters subject to Waterways license jurisdiction (seaward of mean high water mark)
Priority area for state and federal funding (landward of mean high water mark)
CHARLES-TOWN
EAST BOSTON
NORTH END
BOSTON INNER HARBOR
NOAA National Ocean Survey Nautical Chart #13272, Jan 1978
Designated Port Area:
SOUTH BOSTON
DESIGNATED PORT AREA CONSISTS OF
Scale in Yards
0
1000
Selected area within those waters subject to Waterways license jurisdiction (seaward of mean high water mark)
Priority area for state and federal funding (landward of mean high water mark)
BOSTON INNER HARBOR
U.S. Naval Reservation
U.S. Naval Reservation
First St
Broadway
SOUTH BOSTON
PLEASURE BAY
NOAA National Ocean Survey Nautical Chart #13272, Jan 1978

FIGURE 7-1: PROJECT SPECIFIC DESIGNATED PORT AREAS

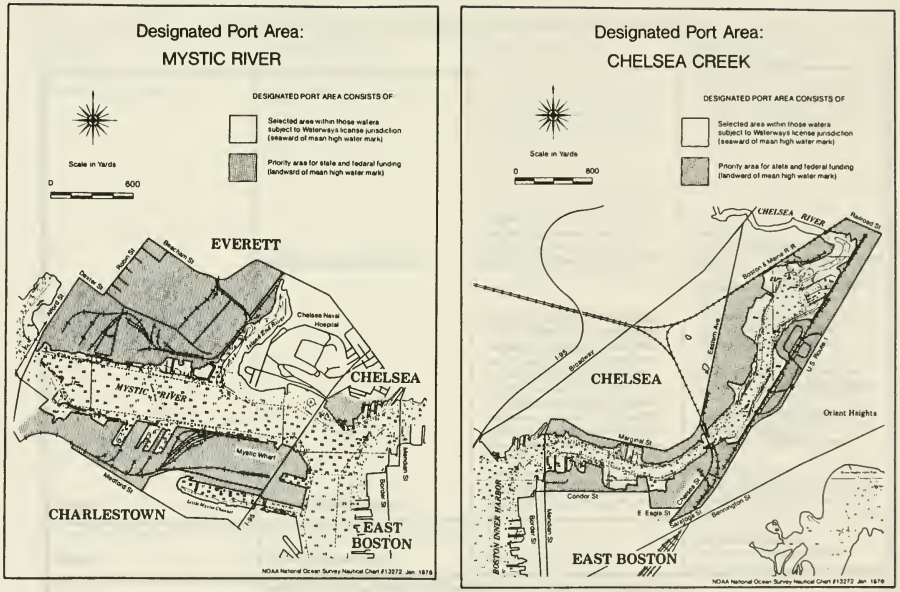


FIGURE 7-2: PROJECT SPECIFIC DESIGNATED PORT AREAS

TABLE 7-1: ACCEPTABILITY CONDITIONS FOR ACTIVITIES WITHIN DPA'S

Activity	Interest to be Protected	Adverse Effects to Interest	Conditions Required to Meet Performance Standards
Dredging	Protection of marine fisheries	• Dredging may adversely affect water circulation by creating areas of stagnation	• Dredge channel and port area so that all portions of them will be adequately flushed by the tides.
		• Dredging may adversely affect water quality by changing dissolved oxygen, temperature, turbidity, or by stirring up pollutants in the bottom sediments. A high concentration of certain pollutants in the bottom sediments, such as PCB's or heavy metals, may preclude the possibility of dredging under the regulations of the Division of Water Pollution Control (DWPC).	• Complete the dredging operation as quickly as possible by using the most efficient and practical equipment. • Where possible, schedule dredging so as not to conflict with fisheries use. • Bottom sediment analysis and evaluation of dredging should be coordinated with the DWPC. • Minimize the amount of dredging.
	Storm damage prevention and flood control	• Extensive dredging of a port area may increase wave height, which may increase their potential destructive energy.	• Whenever possible, channel axis should not be parallel to direction of major storm waves.

TABLE 7-1: ACCEPTABILITY CONDITIONS FOR ACTIVITIES WITHIN DPA'S (continued)

Activity	Interest to be Protected	Adverse Effects to Interest	Conditions Required to Meet Performance Standards
Dredge Material Disposal	Storm damage prevention and flood control	• Disposal of dredged material may cause shoaling of nearshore land under ocean which will interrupt sediment transport processes, thereby affecting the volume and form of coastal beaches. • Disposal of clean dredged material may cause the shoaling of nearshore land under the ocean which can create areas of stagnation.	• Wave height at any point along the shoreline shall not increase by more than 10% by disposal of dredged material on nearshore areas of land under ocean.
	Protection of marine fisheries	• Disposal of clean dredged material can alter the distribution of sediment grain size. • Disposal of clean dredged material may bury eel grass beds.	• Disposal of spoil in discontinuous bands, interrupted at least every 250 ft. by 50 ft. breaks to provide for passage of water, nutrients and aquatic life. (These figures are guidelines only; the concept should be adjusted as necessary in the particular project). • Dredged material disposal on any portion of land under the ocean shall have a mean grain size distribution which does not differ from the existing land under the ocean sediment grain size by more than 50% . • Disposal of dredged material should avoid eel grass beds to the maximum extent possible.

TABLE 7-1: ACCEPTABILITY CONDITIONS FOR ACTIVITIES WITHIN DPA'S (continued)

Activity	Interest to be Protected	Adverse Effects to Interest	Conditions Required to Meet Performance Standards
Fill	Protection of marine fisheries	• The process of placing fill behind or within seawalls or bulkheads may cause turbidity and sedimentation. • Pollutants which may be present in the fill may be leached out into or resuspended in the water column.	• Fill must be contained withlo a seawall, bulkhead, or revetment permitted by the Regulations. • The area to be filled shall be dewatered prior to placement of the fill or a siltation curtain shall be placed immediately around the retaining structure to contain the material suspended in the water displaced as the area is filled, where conditions permit. • Only clean fill may be permitted (see description of clean fill in the waterways (c. 91) regulations.
Seawalls, Bulkheads, and Revetments	Protection of marine fisheries Storm damage prevention and control	• Construction of seawalls, bulkheads and revetments are likely to adversely affect water quality by generating turbidity in the area. • The placement of seawalls, bulkheads and revetments within the DPA's is not likely to have an adverse effect to storm damage prevention and flood , control.	• The construction should be accomplished as quickly as possible using the most efficient and practicsl equipment. • No conditions are necessary

TABLE 7-1: ACCEPTABILITY CONDITIONS FOR ACTIVITIES WITHIN DPA'S (continued)

Activity	Interest to be Protected	Adverse Effects to Interest	Conditions required to Meet Performance Standards
Point Discharges (de-watering)	Protection of marine fisheries	• Runoff from roads and parking lots or other paved surfaces contains pollutants such as oil, grease, heavy metals and particulate matter, thereby adversely affecting water quality.	• Sedimentation or catch basins as appropriate to the amount of runoff. • Gas traps. • Periodic maintenance and cleaning of the basins and traps. • Periodic cleaning of debris from paved surfaces.
	Storm damage prevention and flood control	• Headwall and support may interrupt sediment transport.	• Headwall and supports must be spaced so that sediment transport is not interrupted.
Piers, Docks, Wharves, Floats, Piles and Dolphins	Storm damage prevention and flood control	• Piers, piles, etc., are unlikely to have an adverse effect on storm damage prevention in DPA's.	• No conditions are necessary.
	Protection of marine fisheries	• Piers, piles, etc., which are too close together may alter water circulation and cause areas of stagnation, thereby adversely affecting water quality.	• Space piles as far apart as practical for the structure being built, in no case less than 10 feet apart.
		• Installation of piles, piers, etc., may cause turbidity and sedimentation during the construction process.	• Construction shall be completed as quickly as possible to minimize the amount of turbidity and sedimentation.

Information contained in this table from:
A Guide to Coastal Wetlands Regulations of the Massachusetts Wetlands Protection Act G.L. 131, s.40, Cooperative Extension Service, UMASS, Amherst, 1978.

TABLE 7-2: NORMALLY APPROVABLE DREDGING HANDLING AND DISPOSAL OPTIONS									
Chemical Type (Table I)	Category One			Category Two			Category Three		
Physical Type (Table II)	A	B	C	A	B	C	A	B	C
DREDGING METHODS									
Hydraulic	X	X	X	X	X	X	X	X	X
Mechanical	X	X	X	X	X	X	X	X	X
DISPOSAL METHODS									
Hydraulic: Sidecast	X	X	O	O	O	O	O	O	O
Hydraulic: Pipeline	X	X	X	X	X	X	X	X	X
Mechanical: Sidecast	X	X	O	O	O	O	O	O	O
Mechanical: Barge	X	X	X	X	X	X	X	X	X
PLACEMENT									
Land or in-harbor disposal with bulk-heading	X	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Open ocean disposal at high energy, sandy sites	X	O	O	O	O	O	O	O	O
Open ocean disposal at low energy, sandy sites	O	X	(b)	O	(b)	(b)	(b)	(b)	(b)
Unconfined in-harbor	X	O	O	O	O	O	O	O	O
Beach Replenishment	X	O	O	O	O	O	O	O	O
OTHER CONDITIONS									
Timing and placement to Avoid Fisheries Impacts (spawning and running periods and areas)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)

Legend X = Normally approvable
O = Not normally approvable
(a) = Normally approvable but control of effluent will be required
(b) = Approvable only after bioassay, performed in accordance with established EPA procedures, indicates no significant biological impact. A statistically comparable project which has successfully passed the bioassay test may be substituted. If a significant biological impact is found, this material is unsuitable for open water disposal.
(c) = Required in all cases

TABLE 7-3 FACTUAL DETERMINATION: IN-CHANNEL SITES

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Contaminated silt overlying clean parent material (clay).	Post-dredge and disposal substrate will be clean parent and/or capping material (clay or sand).	Clean parent material will eventually be covered with new silts from point and non-point discharges.
WATER CIRCULATION, FLUCTUATION, AND SALINITY	130 billion gallon tidal prism.	No impacts anticipated.	No additional impacts are anticipated.
TURBIDITY/TSS	Class SB water (314 CMR 4.05-4.06), an urbanized estuarine condition.	≤ 700 mg/l @ surface for up to 600 m, ≤ 1,100 mg/l @ bottom for up to 1000 m, (LaSalle etal 1991); any plume should rapidly dissipate.	Should return to Class SB water in an urbanized estuarine condition.
CONTAMINANTS	Class SB water (314 CMR 4.05 -4.06), silts are considered contaminated, parent material and rock considered clean.	Low potential for substantial degredation of ambient water quality, substrate conditions should greatly improve with the removal of the contaminated silts.	As future siltation proceeds, the substrate condition will to deteriorate.
AQUATIC ECOSYSTEM	Opportunistic/pioneer benthic community, marginally significant transient fishery and a fish run.	Opportunistic/pioneer species should recolonize and rework new substrate material, transient aquatic macrofauna should return following dredging activities, there are some losses to finfish expected due to blasting of rock.	Opportunistic/pioneer species should recolonize and rework new substrate material, transient aquatic macrofauna should return following dredging activities, there are some losses to finfish expected due to blasting of rock.
MIXING ZONE	Open water site with no existing mixing zone.	During disposal activities, isolated with silt curtains/barriers, a vertical mixing zone will include the water column overlying the pit; localized and temporery turbidity events should dissipate rapidly.	No additional impacts are anticipated.
CUMULATIVE EFFECTS	Benthic substrate is currently degraded due to the on-going silting of the harbor and the contaminated point and non-point discharges to the harbor.	Dredging and capping of in-channel disposal cells will expose clean parent material as new substrate.	As future siltation proceeds, the substrate condition will continue to deteriorate.
SECONDARY EFFECTS	Contaminated silts will remain exposed as the bottom substrate in the inner harbor and berthing areas.	Creation of 116 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit to the area and rework new sediments; limited hard substrate habitat will remain; and finfish utilization will be limited to periods of [illegible]station.	Biological communities and habitats should further improve with the on-going improvements to the Boston Harbor System and water quality.

TABLE 7-3 (CON'T) FACTUAL L ERMINATION: AMSTAR SITE

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Three types of existing intertidal substrate; hard substrate (pilings and seawalls), gravel/cobble beach, and boulders; also 3.5 acres of category III gray silty/clays.	Creation of 3.5 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit to the area and bioturbate new sediments.	Intertidal habitat should should be limited by surrounding conditions, no additional impacts are anticipated.
WATER CIRCULATION, FLUCTUATION, AND SALINITY	Circulation at Amstar influenced by tidal exchange.	Less exchange since bottom elevation will be increased, will remain intertidal.	No additional impacts anticipated.
TURBIDITY/TSS	Class SB water in an urbanized estuarine condition.	Localized and temproary impacts are anticipated during the disposal operation at Amstar, silt curtains should isolate turbid conditions to a limited area.	Siltation curtains and barriers should remain and be maintained until any turbidity plume dissipates, and poses little to no risk to receiving waters.
CONTAMINANTS	Class SB water in an urbanized estuarine condition.	Sequestering of 128,000 cy of silt should isolate contaminats from the Mystic River environment.	No additional impacts anticipated.
AQUATIC ECOSYSTEM	Existing conditons include barnacle, mussel, green algae and *Fucus sp.* on hard substrate; polychaetes, oligochaetes and nematodes in the soft substrate; and the protected waters within the berthing area provide finfish refuge and forage habitat.	Loss of subtidal substrates will displace existing benthic invertebrates (polychaetes and oligochaetes and nematodes), reduce productivity of barnacles, mussels and green algae; finfish utilization will also be altered, and limited to periods of tidal inundation.	Creation of 3.5 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit to the area and rework new sediments; limited hard substrate habitat will remain; and finfish utilization will be limited to periods of inundation.
MIXING ZONE	Abandoned berthing area with no existing mixing zone.	During disposal activities, isolated with silt curtains/barriers, a vertical mixing zone will include the entire and subtidal water columns within the site, and turbidity should settle and/or slowly be diluted by tidal circulation.	Siltation curtains and barrier should remain and be maintained until any turbidity plume dissipates, and poses little to know risk to receiving waters.
CUMULATIVE EFFECTS	Benthic substrate is currently degraded due to the on-going silting of the harbor system, and the contaminated point and non-point discharges.	Sequestering of 128,000 cy of contaminated silts over 3.5 acres of degraded benthic habitat, and a permanent loss of 3.5 acres of subtidal habitat.	Creation of 3.3 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit to the area and rework new sediments; limited hard substrate habitat will remain; and finfish utilization will be limited to periods of inundation.
SECONDARY EFFECTS	Site remains in an abandoned, degraded condition; with a potential for future development.	Creation of 3.5 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit to the area and rework new sediments; limited hard substrate habitat will remain; and finfish utilization will be limited to periods of inundation.	Biological communities and habitats should further improve with the on-going improvements to the Boston Harbor System and water quality.

TABLE 7-3 (CON'T) FACTUAL DETERMINATION: BOSTON LIGHTSHIP SITE (BLS)

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Sedimentary and depositional environment dominated muddy sands and mud; historic disposal indicates that hazardous and low level radioactive wastes are present at the site.	Deposition of silt and clay should be compatible with existing substrate variability and character; unconfined disposal will compound historic contamination problems.	Unsecured contaminated silts may have limiting effects on individuals recolonizing the disposal area; risks are anticipated to be limited.
WATER CIRCULATION, FLUCTUATION AND SALINITY	Open ocean circulation influenced by tides and winds.	Changes in bottom contours should not alter existing surface water hydrology.	No additional impacts are anticipated.
TURBIDITY/TSS	Class SA water Quality, limited turbidity.	≤ 700 mg/l @ surface for up tp 600 m, ≤ 1,100 mg/l @ bottom up tp 1000 m, (LaSalle etal 1991); any plume should rapidly dissipate.	No additional impacts are anticipated.
CONTAMINANTS	Surface waters appear relatively free of contaminants, but sediments are suspected of being contaminated with hazardous and low-level radioactive wastes.	Project specific modelling (REFERENCE) indicates that limited water quality degradation should be anticipated during disposal, in the worst case, degredation should be limited and rapidly dissipated within hours of disposal.	Since BLS is suspected of containing unsecured wastes, the addition of contaminated silts from BNNIP should have little additional effects to the area.
AQUATIC ECOSYSTEM	Sediments are dominated by an amphipod/polychaete, nemertean worm and burrowing anemone community; and both the lobster and finfish community are significant and representative of a typical Gulf of Maine fishery.	A portion of the benthic resources should be lost during disposal activities, but should rapidly recolonize following the activities, lobster and finfish resources should evacuate the area during operations and should also return following the cessation of activities.	As the regenerating ecosystem develops, the fishery community should also respond with greater abundance and diversity.
MIXING ZONE	Open water site with no existing mixing zone.	During open water disposal the vertical mixing you will include the water column overlying the target area, localized and temporary turbidity events should dissipate rapidly.	No additional impacts are anticipated.
CUMULATIVE EFFECTS	An area of potentially degraded sediments which is heavily fished commercially.	Disposal of -- cy of contaminated silt should have limited effects on areal water quality; these activities will cause short term reductions on fishery resources, abundances and diversity.	Unsecured contaminated silts may have limited, but continued effects on individuals recolonizing the disposal area; risks are anticipated to be limited.
SECONDARY EFFECTS	Availability of suitable disposal areas are limited, therefore non-use could limit future disposal options.	Current and documented fishing activities (commercial and recreational) would be interrupted during the disposal operations.	Use of the site for future maintenance dredge material disposal could periodically interrupt offshore fishing activities.

TABLE 7-3 (CON'T) FACTUAL DETERMINATION: LITTLE MYSTIC CHANNEL (LMC)

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Fine grained silt/clay with elevated metal levels (Category II and III-514 CMR 9.00), and elevated levels of PAH's, TPH,s and PCB's.	Temporary loss of 155 acres of existing substrate, replaces with clean parent material capping and sequestering contaminated dredge material and existing substrate.	Cap material placed at the site should be quickly recolonized and reworked.
WATER CIRCULATION, FLUCTUATION AND SALINITY	Circulation in LMC is influenced by tidal exchange, six discharge pipes and a CSO.	No impacts are anticipated.	No additional impacts are anticipated.
TURBIDITY/TSS	Class SC water (314 CMR 4.05-4.06), an urbanized estuarine condition.	Localized and temporary impacts are anticipated during disposal operations in LMC, silt curtains should isolated turbidity within a limited area.	No additional impacts are anticipated.
CONTAMINANTS	Class SC water (514 CMR 4.05-4.06), an urbanized estuarine condition; depressed DO; and polyhaline.	Post disposal substrate will be clean parent and or capping material (clay or sand), over 15.5 acres of existing benthic substrate; contaminants should be sequestered	No additional impacts are anticipated.
AQUATIC ECOSYSTEM	Benthic infauna include oligochaetes, polychaetes and nematodes, limited lobster; and several finfish are associated with the main ship channel, and should move in and out of LMC.	Benthic infauna impacts should be temporary and recolonization of opportunistic/pioneer species should occur in the capping material; motile species will evacuate the work area and those not limited by depth requirements should return post activity.	Creation of 15.5 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit to the area and bioturbate new sediments; limited hard substrate habitat will remain; and finfish utilization will be limited to periods of inundation.
MIXING ZONE	Open water site with no existing mixing zone, but adjacent to shore-based discharge/ CSO's.	During disposal activities, isolated with silt curtains/barriers, a vertical mixing zone will include the entire and subtidal water columns within the site, and turbidity should settle and/or slowly be diluted by tidal circulation.	Siltation curtains and barrier should remain and be maintained until any turbidity plume dissipates, and poses little to know risk to receiving waters.
CUMULATIVE EFFECTS	Benthic substrate and water quality are currently degraded due to the on-going silting of the harbor, and the contaminated point and non-point discharges to the harbor.	Disposal and sequestering contaminated silts and capping, over the existing degraded substrate will provide clean substrate for recolonization.	Creation of 15.5 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit to the area and rework new sediments; limited hard substrate habitat will remain; and finfish utilization will be limited to periods of inundation.
SECONDARY EFFECTS	Site remains in an abandoned, degraded condition; with a potential for future development.	Creation of 15.5 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit to the area and rework new sediments; limited hard substrate habitat will remain; and finfish utilization will be limited to periods of inundation.	Biological communities and habitats should further improve with the on-going improvements to the Boston Harbor System and water quality

TABLE 7-3 (CON'T) FACTUAL DETERMINATION: MASSACHUSETTS BAY DISPOSAL SITE (MBDS)

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	A permitted open ocean disposal site with varying sediment characteristics and quality; subject of historic disposal, sandy silt and fine silt/clay ranging from low to high levels of various contaminants.	Continued variable texture and quality.	No additional impacts are anticipated.
WATER CIRCULATION, FLUCTUATION AND SALINITY	Open ocean circulation influenced by tides and winds.	Changes in bottom contours at this deep water site should not alter existing surface water hydrology.	No additional impacts are anticipated.
TURBIDITY/TSS	Open ocean water considered relatively clean, therefore limited turbidity.	≤ 700 mg/l @ surface for up tp 600 m, ≤ 1,100 mg/l @ bottom for up tp 1000 m, (LaSalle etal 1991); any plume should rapidly dissipate.	No additional impacts are anticipated.
CONTAMINANTS	Surface waters appear relatively free of contaminants, but sediments contain levels ranging from low to high relative to various contaminants.	Project specific modelling (REFERENCE) indicates that limited water quality degradation should be anticipated during disposal, in the worst case, degradation should be limited and rapidly dissipated within hours of disposal; unsecured contaminated silts may have limited, but continued effects on individuals recolonizing MBDS, risks are anticipated to be limited.	Since MBDS contains unsecured wastes, the addition of unsecured or capped contaminated silts from BHNIP should have little additional effect to the habitats of this permitted disposal site.
AQUATIC ECOSYSTEM	Sediments are dominated by a variety of polychaetes and oligochaetes; both the lobster and finfish communities are significant and representative of a typical Gulf of Maine fishery with some southern influences.	A portion of the benthic resources should be lost during disposal activities, but should rapidly recolonize following operations; lobster and finfish resources should evacuate the area during operations and should also return following the cessation of activities.	As the regenerating ecosystem develops, the fishery community should also respond with greater abundance and diversity.
MIXING ZONE	Open water site with no existing mixing zone.	During open water disposal the vertical mixing you will include the water column overlying the target area, localized and temporary turbidity events should dissipate rapidly.	No additional impacts are anticipated.
CUMULATIVE EFFECTS	An area of degraded sediments which is heavily fished commercially.	Disposal of clean parent materials should have limited effects on areal water quality; these activities will cause short termreductions on fishery resources, abundances and diversity.	Unsecured contaminated silts may have limiting effects on individuals recolonizing MBDS, risks are anticipated to be limited.
SECONDARY EFFECTS	Availability of suitable disposal areas are limited, therefore non-use could limit future disposal options.	Current and documented fishing activities (commercial and recreational) would be interrupted during the disposal operations.	Use of the site for future maintenance dredge material disposal could periodically interrupt offshore fishing activities.

TABEL 7-3 (CON'T) FACTUAL DI .RMINATION: MEISBURGER 2

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Clean sand and gravel, appears suitable for beach nourishment and capping.	Material disposal would occur and be contained within a borrow pit and capped with clean parent material and the final cover would be a portion of the sand and gravel removed during the pit construction; and therefore would be similar to existing conditions.	No additional impacts are anticipated.
WATER CIRCULATION, FLUCTUATION AND SALINITY	Open ocean circulation influenced by tides, winds and major riverflow.	Underwater contours would be returned to pre-project conditions, with the final capping of sand and gravel.	No additional impacts are anticipated.
TURBIDITY/TSS	Class SA water quality, limited turbidity.	≤ 700 mg/l @ surface for up tp 600 m, ≤ 1,100 mg/l @ bottom for up tp 1000m, (laSalle etal 1991); any plume should rapidly dissipate.	No additional impacts are anticipated.
CONTAMINANTS	Surface waters and sediments appear relatively free of contamination.	Project specific modelling (REFERENCE) indicates that limited water quality problems should be anticipated during pit construction and moreover, during disposal; in the worst case degredation should be limited and rapidly dissipated and diluted.	No additional impacts are anticipated.
AQUATIC ECOSYSTEM	Sediments dominated by amphipod/polychaete assemblage, lobster appear significant to the area, and the finfish community is significant and comprised of typical Gulf of Maine demersal and pelagic structure with some southern influences (NA 1995).	Benthic community will be completely lost during pit construction, but should recolonize the final cap after disposal operations are completed, lobster and finfish resources should evacuate the area during operations and should also return to the area following the cessation of activities.	As the regenerating ecosystem develops, the fishery community should also respond with greater numbers and diversity.
MIXING ZONE	Open water site with no existing mixing zone.	During open water disposal the vertical mixing you will include the water column overlying the target area, localized and temporary turbidity events should dissipate rapidly.	No additional impacts are anticipated.
CUMULATIVE EFFECTS	An area relatively free of contaminants, which is heavily fished commercially.	Sequestering of 10^6 - 10^7 cy of dredged material and future maintenance material within the borrow pit, capped with clean parent material will have limited effects on areal water quality, which will occur only during project activites; these activities will cause short term reductions on fishery resources, abundance and diversity.	As the regenerating ecosystem develops, the fishery community should also respond with greater numbers and diversity.
SECONDARY EFFECTS	Availability of suitable disposal areas are limited, therefore non-use could limit future disposal options.	Current and documented fishing activities (commercial and recreational) would be interrupted during the disposal operations.	Use of the site for future maintenance dredge material disposal could periodically interrupt offshore fishing activities.

TABLE 7-3 (CON'T) FACTUAL DETERMINATION: MEISBURGER 7

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Clean sand and gravel, appears suitable for beach nourishment and capping	Material disposal would occur and be contained within a borrow pit and capped with clean parent material and the final cover would be a portion of the sand and gravel removed during the pit construction; and therefore would be similar to existing conditions.	No additional impacts are anticipated
WATER CIRCULATION, FLUCTUATION AND SALINITY	Open ocean circulation influenced by tides, winds and major riverflow.	Underwater contours would be returned to pre-project conditions, with the final capping of sand and gravel.	No additional impacts are anticipated.
TURBIDITY/TSS	Class SA water quality, limited turbidity.	≤ 700 mg/l @ surface up tp 600 m, ≤ 1,100 mg/l @ bottom for up tp 1000 m, (LaSalle etal 1991); any plume should rapidly dissipate.	No additional impacts are anticipated.
CONTAMINANTS	Surface waters and sediments appear relatively free of contamination.	Project specific modelling (**REFERENCE**) indicates that limited water quality problems should be anticipated during pit construction and moreover, during disposal; in the worst case degradation should be limited and rapidly dissipated and diluted.	No additional impacts are anticipated
AQUATIC ECOSYSTEM	Sediments dominated by amphipod/polychaete assemblage, lobster appear significant to the area, and the finfish community is significant and comprised of typical Gulf of Maine demersal and pelagic structure with some southern influences (NA 1995).	Benthic community will be completely lost during pit construction, but should recolonize the final cap after disposal operations are completed, lobster and finfish resources should evacuate the area during operations and should also return to the area following the cessation of activities.	As the regenerating ecosystem develops, the fishery community should also respond with greater numbers and diversity.
MIXING ZONE	Open water site with no existing mixing zone.	During open water disposal the vertical mixing you will include the water column overlying the target area, localized and temporary turbidity events should dissipate rapidly.	No additional impacts are anticipated.
CUMULATIVE EFFECTS	An area relatively free of contaminants, which is heavily fished commercially.	Sequestering of up to 19.5 million cy of material and future maintenance material within the borrow pit, capped with clean parent material will have limited effects on areal water quality, which will occur only during project activities; these activities will cause short term reductions on fishery resources, abundance and diversity.	As the regenerating ecosystem develops, the fishery community should also respond with greater numbers and diversity.
SECONDARY EFFECTS	Availability of suitable disposal areas are limited, therefore non-use could limit future disposal options.	Current and documented fishing activities (commercial and recreational) would be interrupted during the disposal operations.	Use of the site for future maintenance dredge material disposal could periodically interrupt offshore fishing activities.

TABLE 7-3 (CON'T) FACTUAL DETERMINATION: MYSTIC PIERS 49-50

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Contaminated silt overlying clean parent material.	Displacement of 2.7 acres of contaminated silty substrate.	Sequestering of 98,000 cy of contaminated silts over 2.7 acres of degraded benthic substrate.
WATER CIRCULATION, FLUCTUATION AND SALINITY	Circulation influenced by tidal exchange.	Entire watersheet area lost to fastland.	No additional impacts are anticipated.
TURBIDITY/TSS	Class SB water in an urbanized estuarine condition.	Sheet pile bulkhead and dewatering, limited turbidity when the bulkhead is driven.	No additional impacts are anticipated.
CONTAMINANTS	Contaminated silt overlying clean parent material.	Sequestering of 98,000 cy of contaminated silts over 2.7 acres of degraded benthic substrate.	No additional impact are anticipated.
AQUATIC ECOSYSTEM	Areal opportunistic/pioneer benthic community, fairly significant transient and brood fishery, and fish run in adjacent river habitat.	Permanent loss of 2.7 acres of aquatic habitat.	Permanent loss of 2.7 acres of aquatic habitat.
MIXING ZONE	Abandoned berthing area with no existing mixing zone.	Mixing zone will be limited to any temporary or permanent dewatering outfall to the Mystic River; any plume should be limited and rapidly dissipated.	No additional impacts are anticipated.
CUMULATIVE EFFECTS	Benthic substrate is currently degraded due to the on-going silting of the harbor system, and the contaminated point and non-point discharges.	Sequestering of 98,000 cy of contaminated silts over 2.7 acres of degraded benthic substrate, and a permanent loss of 2.7 acres of aquatic habitat.	Permanent loss of 2.7 acres of aquatic habitat.
SECONDARY EFFECTS	Site remains in an abandoned, degraded condition; with a potential for future development.	Dewatering discharges.	On-going maintenance of bulkheading to eliminate potential of seeps or releases of sequestered materials.

TABLE 7-3 (CON'T) FACTUAL DETERMINATION: RESERVED CHANNEL (RC) AREA A

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Gray/black silt and clay, contaminated substrate (category II and III).	Temporary loss of 8.9 acres of existing substrate, replaced with clean parent material capping and sequestering contaminated dredge material and existing substrate.	Cap material placed at the site should be quickly recolonized and reworked.
WATER CIRCULATION, FLUCTUATION AND SALINITY	Circulation in RC is influenced by tidal exchange and three CSO's.	Sewer outfall would need to be relocated, no other impacts are anticipated.	No additional impacts are anticipated.
TURBIDITY/TSS	Class SC water (314 CMR 4.05-4.06), an urbanized estuarine condition.	Localized and temporary impacts are anticipated during disposal operation in RC, silt curtains should isolate turbid conditions to a limited area.	No additional impacts are anticipated.
CONTAMINANTS	Gray/black silt and clay, contaminated substrate (category II and III); class SC water (314 CMR 4.05-4.06), an urbanized estuarine condition.	Sequestering of 14,000 cy of silt should isolate contaminats from the areal environment.	No additional impacts are anticipated.
AQUATIC ECOSYSTEM	Piles, granite seawalls, floating docks and metal bulkheads support green algae, *Fucus sp.*, barnacles, and periwinkles; soft sediments contain oligochaetes, polychaetes and nematodes; finfish habitat is present, but appears limited to transient use, although flounder spawning habitat may be present	Loss of subtidal substrates displacing existing benthic invertebrates (poychaetes, oligochaetes and nematodes), reduce productivity of barnacles, mussels and algae; finfish utilization will also be altered, and limited to periods of tidal inundation; any flounder spawning habitat will be lost.	Creation of 8.9 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit and bioturbate new sediments; limited hard substrates will remain; and finfish utilization will be limited to periods of tidal inundation.
MIXING ZONE	Open water site with no existing mixing zone, but adjacent to shore-based discharge/CSO's.	During disposal activities, isolated with silt curtains/barriers, a vertical mixing zone will include the entire intertidal and subtidal water columns within the site, and turbidity should settle and/or slowly be diluted by tidal circulation	Siltation curtains and barriers should remain and be maintained until any turbidity plume dissipates, and poses little to no risk to receiving waters.
CUMULATIVE EFFECTS	Benthic substrate is currently degraded due to the on-going silting of the harbor system, and the contaminated point and non-point discharges.	Sequestering of 14,000 cy of contaminated silts over 8.9 acres of degraded benthic habitat, and a permanent loss of 8.9 acres of subtidal habitat.	Creation of 8.9 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit and rework new sediments; limited hard substrates will remain; and finfish utilization will be limited to periods of tidal inundation.
SECONDARY EFFECTS	Site remains in an abandoned, degraded condition; with a potential for future development.	Creation of 8.9 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit and rework new sediments; limited hard substrates will remain; and finfish utilization will be limited riods of tidal inundation.	Biological communities and habitats should further improve with the on-going improvements to the Boston Harbor System and water quality.

TABLE 7-3 (CON'T) FACTUAL DETERMINA..ON: RESERVED CHANNEL (RC) AREA B

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Grey/black silt and clay, contaminated substrate (category II and III).	Temporary loss of 7.7 acres of existing substrate, replaced with clean parent material capping and sequestering dredge material and existing substrate.	Cap material placed at the site should be quickly recolonized and reworked.
WATER CIRCULATION, FLUCTUATION AND SALINITY	Circulation in RC is influenced by tidal exchange and three CSO's	Sewer outfall would need to be relocated, no other impacts are anticipated.	No additional impacts are anticipated.
TURBIDITY/TSS	Class SC water (314 CMR 4.05-4.06), an urbanized estuarine condition.	Localized and temporary impacts are anticipated during disposal operation in RC, silt curtains should isolate turbid conditions to a limited area	No additional impacts are anticipated.
CONTAMINANTS	Grey/black silt and clay, contaminated substrate (category II and III); class SC water (314 CMR 4.05-4.06), an urbanized estuarine condition.	Sequestering of __ cy of silt should isolate contaminants from the areal environment.	No additional impacts are anticipated.
AQUATIC ECOSYSTEM	Steel bulkhead, granite seawall and sloping rip-rap supports a moderate growth of *Fucus sp., Ulva sp.* and *Enteromorpho sp.* and barnacles; small gravel beach supports periwinkles; soft substrates support polychaetes, oligochaetes and nematodes; finfish habitat is present, but appears limited to transient use, although flounder spawning habitat may be present.	Loss of subtidal substrates displacing existing benthic invertebrates (polychaetes, oligochaetes and nematodes); reduced productivity of barnacles, mussels and algae; finfish utilization will also be altered, and limited to periods of tidal inundation; any flounder spawning habitat will be lost.	Creation of 7.7 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit and rework new sediments; limited hard substrates will remain; and finfish utilization will be limited to periods of tidal inundation
MIXING ZONE	Open water site with no existing mixing zone, but adjacent to shore-based discharges/CSO's.	During disposal activities, isolated with silt curtains/barrier, a vertical mixing zone will include the entire intertidal and subtidal water columns within the site, and turbidity should settle and/or slowly be diluted by tidal circulation.	Siltation curtains and barriers should remain and be maintained until any turbidity plume dissipates, and poses little to no risk to receiving waters.
CUMULATIVE EFFECTS	Benthic substrate is currently degraded due to the on-going silting of the harbor system, and the contaminated point and non-point discharges.	Sequestering of __ cy of contaminated silts over 7.7 acres of degraded benthic habitat, and a permanent loss of 7.7 acres of subtidal habitat.	Creation of 7.7 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit and bioturbate new sediments; limited hard substrates will remain; and finfish utilization will be limited to periods of tidal inundation.
SECONDARY EFFECTS	Site remains in an abandoned, degraded condition; with a potential for future development.	Creation of 7.7 acres of clean parent material intertidal habitat will replace degraded intertidal and subtidal conditions; opportunistic and pioneer species should naturally recruit and rework new sediments; limited hard substrates will remain, and finfish utilization will be limited to periods of tidal inundation.	Biological communities and habitats should further improve with the on-going improvements to the Boston Harbor System and water quality.

TABLE 7-3 (CON'T) FACTUAL DETERMINATION: REVERE SUGAR

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Contaminated silt overlying clean parent material.	Displacement of 3.7 acres of contaminated silty substrate.	Sequestering of 85,000 cy of contaminated silts over 3.7 acres of degraded benthic substrate.
WATER CIRCULATION, FLUCTUATION AND SALINITY	Circulation influenced by tidal exchange.	Entire watersheet area lost to fastland.	No additional impacts are anticipated.
TURBIDITY/TSS	Class SB water in an urbanized estuarine condition.	Sheet pile bulkhead and dewatering, limited turbidity when the bulkhead is driven.	No additional impacts are anticipated.
CONTAMINANTS	Contaminated silt overlying clean parent material.	Sequestering of 85,000 cy of contaminated silts over 3.7 acres of degraded benthic substrate.	No additional impacts are anticipated.
AQUATIC ECOSYSTEM	Areal opportunistic/pioneer benthic community, fairly significant transient and brood fishery, and fish run in adjacent river habitat.	Permanent loss of 3.7 acres of aquatic habitat.	Permanent loss of 3.7 acres of aquatic habitat.
MIXING ZONE	Abandoned berthing area with no existing mixing zone.	Mixing zone will be limited to any temporary or permanent dewatering outfall to the Mystic River; any plume should be limited and rapidly dissipated.	No additional impacts are anticipated.
CUMULATIVE EFFECTS	Benthic substrate is currently degraded due to the on-going silting of the harbor system, and the contaminated point and non-point discharges.	Sequestering of 85,000 cy of contaminated silts over 3.7 acres of degraded benthic substrate, and a permanent loss of 3.7 acres of aquatic habitat.	Permanent loss of 3.7 acres of aquatic habitat.
SECONDARY EFFECTS	Site remains in an abandoned, degraded condition; with a potential for future development.	Dewatering discharges.	On-going maintenance of bulkheading to eliminate potential for seeps or releases of sequestered materials.

TABLE 7-3 (CON'T) FACTUAL DETERMINATION: SPECTACLE ISLAND CAD

404(B)(1) GUIDELINES	*EXISTING CONDITIONS*	*SHORT-TERM CONDITIONS*	*LONG-TERM CONDITIONS*
SUBSTRATE	Fine sand, silt and clay; Category I (314 CMR 9.00, generally clear of contaminants; high levels of arsenic in both surface and deep sediments.	Capping of the disposal pit with parent material, and final capping with on-site borrow material should preserve existing substrate conditions.	No additional impacts are anticipated.
WATER CIRCULATION, FLUCTUATION AND SALINITY	Tidal circulation dominates with wave heights ranging from 0.09-2.6 ft and wave powers of 0.1-412.9 ft lbs/sec.	Cap elevation will mimic existing bathymetry.	No additional impacts are anticipated.
TURBIDITY/TSS	Class SB water (314 CMR 4.05-4.06), influenced by raw sewage discharges, CSO's, various industrial discharges, and urban runoff.	≤ 700 mg/l @ surface for up to 600 m, ≤ 1,100 mg/l @ bottom for up to 1000 m (LaSalle etal 1991); any plume should rapidly dissipate.	Should return to Class SB water.
CONTAMINANTS	Fine sand, silt and clay; Category I (314 CMR 9.00, generally clear of contaminants; high levels of arsenic in both surface and deep sediments.	Capping of the disposal pit with parent material, and final capping with on-site borrow material should preserve existing substrate conditions.	No additional impacts are anticipated.
AQUATIC ECOSYSTEM	Benthic resources are dominated by amphipods, gastropods and nereid worms; EPB lobsters; and forage and predator finfish species.	After construction/and disposal activities, opportunistic/pioneer benthic resources should recolonize the site.	Benthic resources should continue to be dominated by amphipods, gastropods and nereid worms; EPB lobsters; and forage and predator finfish species.
MIXING ZONE	Open water site with no existing mixing zone.	During disposal activities, isolated with silt curtains/barriers, a vertical mixing zone will include the water column overlying the pit; localized and temporary turbidity events should dissipate rapidly.	No additional impacts are anticipated.
CUMULATIVE EFFECTS	The area has been affected by the historic Spectacle Island Landfill; however, this condition should be improving based on CA/T capping and securing of the island.	No impacts are anticipated.	No additional impacts are anticipated.
SECONDARY EFFECTS	Benthic resources are dominated by amphipods, gastropods and nereid worms; EPB lobsters; and forage and predator finfish species.	Benthic resources should continue to be dominated by amphipods, gastropods and nereid worms; EPB lobsters; and forage and predator finfish species.	Biological communities and habitats should further improve with the on-going improvements to the Boston Harbor System and water quality.

Chapter Eight: Draft Section 61 Findings

This chapter of the FEIR/S presents draft Section 61 Findings as required by M.G.L. c. 30 § 61. The MEPA regulations (301 CMR 11.01 (3)) require review and evaluation of projects to determine whether all feasible means and measures will be used to avoid or minimize damage to the environment. The draft evaluation required by M.G.L. c. 30 § 61 can be contained in the EIR and the required findings should be based on the EIR. No agency may act on a permit or commence a project until this finding is complete.

This chapter contains a Draft Section 61 finding to comply with Massport's responsibilities as the project's local sponsor. A final finding will be prepared by Massport after two key events occur. These are:

- The Secretary issues a certificate on the FEIR/S, and
- The results of a second and final confirmatory sampling round of fisheries, benthics and lobster resources, conducted in April/May 1995, are completed. This data will be made part of the Final Section 61 Finding.

As stated in 301 CMR 11.10, any agency which acts on a project for which an EIR has been prepared must make a finding. This requires DEP to prepare a Section 61 finding before it issues permits and certifications for the BHNIP. This Chapter therefore, also serves to provide a draft finding that the DEP may use as a basis for their required finding.

Section 61 findings typically consist of the following:

- project description;
- overall project impacts;
- specific impacts and mitigation measures for these impacts; and
- a summary of findings.

Section 8.1 contains Massport's draft finding and follows the outline described above. The information presented in each section may be repetitive with preceding information in other sections of this FEIR/S but is repeated as appropriate to complete the draft finding. Section 8.2 contains a model finding for the DEP agencies that will have permitting responsibility for portions of the project.

8.1 DRAFT SECTION 61 FINDING FOR MASSPORT

8.1.1 Project Description

The Boston Harbor Navigation Improvement and Berth Dredging Projects (BHNIP) encompass the deepening of three tributary channels (Reserved Channel, Mystic River Channel and Chelsea Creek Channel) and two areas in the Main Ship Channel (Inner Confluence and the mouth of Reserved Channel) to provide sufficient ship maneuvering areas for the deepened channels; six berth areas that would benefit directly from the channel deepening (Conley 11-13, Prolerized, Distrigas, Moran, Eastern Minerals and Gulf Oil);

and six berth areas and one intake structure that would not benefit directly from (i.e., be connected to) the channel deepening (Boston Army, Boston Edison Intake, Boston Edison Barge, Conley 14-15, Revere Sugar, Mystic Piers 1, 2, 49 and 50). The President Roads Anchorage Area and adjacent channels would be re-marked to enlarge the deep water anchorage without additional dredging. Deepening of the channels to -40 ft MLW (except Chelsea Channel to -38 ft MLW) would allow greater use of the hitherto underutilized -40 ft MLW Entrance Channel and Main Ship Channel (see Figure ES-1).

The improvements to the three Federal channels were proposed as a result of a Feasibility Study completed by the Corps of Engineers in 1988. The three-channel project was selected as the economically and environmentally preferred project alternative. It was authorized by Congress in the Water Resources Development Act of 1990 (P.L. 101-640). The authorized project would allow the Port of Boston to maintain its competitiveness in the highly competitive national and international marine trade business by reducing the cost of transporting goods and thus improving efficiency.

Massachusetts Port Authority (Massport), as local sponsor of the project, submitted an Environmental Notification Form (ENF) to Massachusetts Executive Office of Environmental Affairs in April 1991. The Secretary's Certificate on the ENF required the preparation of an Environmental Impact Report (EIR) with three major areas of focus:

- sediment characterization,
- evaluation of disposal alterna tives, and
- a dredging management plan.

The Corps of Engineers, New England Division, committed to preparing an EIS in 1992 due to the cumulative impacts of Federal actions (maintenance dredging, navigation improvement dredging, and permitting of the associated berthing areas) and the significant public concern over disposal of dredged material. Because the channel improvement and berth dredging projects are intricately linked and interdependent and would be reviewed by the same regulatory audience, it was determined that preparation of a joint Environmental Impact Report/Statement (EIR/S) would be most efficient.

A Draft EIR/S was published in April 1994. The FEIR/S responded to comments received on the Draft including the Secretary's certificate dated June 10, 1994 and complied with the requirements for an FEIR as described in 301 CMR 11.07 (10). The document also met the requirements for an FEIS as specified in 40 CFR Part 1503.

The purpose of the BHNIP is to increase the navigational efficiency and safety of Boston Harbor for present types of deep draft vessels. This purpose was the basis for the 1988 Feasibility Report prepared by the Corps to conclude that the project was justified economically. There are also direct economic benefits that accrue to the Port from the BHNIP. These include: 1) increased navigational efficiency and safety by reducing the need to wait out tides or to decrease loads prior to entering the Harbor; 2) the ability to ship more tons of containerized cargo with fewer ships; 3) the ability to attract new shipping lines;

and 4) ability to maintain vital refined oil products facilities and allow for double-hulled tankers.

The BHNIP will result in removal of approximately 1.1 million cubic yards (cy) of silt (as measured in-place). The total quantity of silt requiring disposal is slightly higher, 1.4 million cy, which accounts for 0.5 feet of over-dredging into the underlying parent material and a 20% expansion factor due to dredging. An extensive sediment sampling and testing program was undertaken to characterize the dredged material. The surficial silt layer (or "maintenance" material) was found to contain varying concentrations of metals, polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and other organics. The sediment bulk chemistry data, in combination with test organism toxicity and bioaccumulation testing, indicated that the silt was generally unsuitable for unconfined open water disposal. The complete chemical and bioassary results are provided in Appendix C of the Draft EIR/S.

It was further determined that the underlying sediment (parent material) was composed of clay and sand/gravel and has low levels of metals and organics. The Corps initially determined that approximately 360,000 cy of silt was suitable for ocean disposal. Using the same data, however, the EPA determined that none of the silt was suitable for unconfined ocean disposal. In response, the Corps adopted the more conservative position and assumed that all silt from the project is considered unsuitable for unconfined ocean disposal.

The underlying parent material, composed primarily of Boston Blue Clay with gravel pockets, has been shown on this and other projects to be uncontaminated and suitable for unconfined open water disposal. The total volume of approximately 2 million cy of parent material (including the expansion factor) can be disposed at an unconfined open water site if no beneficial uses (e.g., landfill and/or capping) are identified. The final component of the dredged material is rock that would be removed from Mystic River Channel and two areas of the Main Ship Channel. Beneficial uses considered for the 132,000 cy (post-dredging volume) of rock included habitat enhancement or armoring disposal sites that are subject to high-energy hydrodynamics.

In addition to addressing the dredged material disposal needs for the BHNIP itself, disposition of the future maintenance of the deepened channels over the 50 year project life was addressed. The estimated 4.4 million cy of future maintenance material would be composed primarily of silt. For the purpose of the disposal alternatives analysis, it has been assumed that this material could contain elevated levels of contaminants. Under this assumption (which may or may not be the case), the material would have to be deposited in a confined disposal site yet to be determined. The BHNIP will not require federal maintenance dredging for an estimated ten years. The Corps has responsibility for maintenance dredging.

An environmental and practicability evaluation of options led to the identification of the in-channel disposal option as the least environmentally damaging and practicable alternative. Chapter Four of the FEIR/S provided the environmental and practicability screening of 24 potential disposal sites. The in-channel option combines three sites within the Harbor. This option disposes of silt

within the dredging footprint of the Mystic and Chelsea Rivers and the Inner Confluence in cells constructed in the parent material that are capped with sand after filling. The in-channel option confines most impacts to the dredging footprint, and is rated the least environmentally damaging practicable alternative (LEDPA).

The FEIR/S also identified a secondary preferred alternative site for excess silt capacity should the preferred alternative fail to provide sufficient capacity after the project is underway. Based on the environmental and practicability screening process mentioned above, the Little Mystic Channel was identified as a secondary contingency site. This site would be filled to mean low water, changing approximately 15 acres from a subtidal, but degraded condition, to intertidal habitat with clean substrate. This option provides approximately 373,000 cy of contingency capacity. If this site is required for secondary capacity, mitigation for change in substrate will be discussed with the appropriate resource agencies when required.

8.1.2 Summary of Project Impacts

Certain short-term adverse effects of the dredging and in-channel disposal would be unavoidable. Some benthic organisms and demersal fish would be killed during dredging and blasting. Substrate in the areas dredged would be temporarily devoid of benthic organisms but would be recolonized in approximately one year, reforming habitat with prey suitable for fin fish. Turbidity would increase temporarily in the area of the dredge. Use of an environmental (closed) bucket will help minimize contaminant release. Other turbidity controls, such as silt curtains, will be assessed in terms of suitability depending on the location of the dredging operation. Close monitoring of the dredging operations, to identify problems and quickly seek corrective measures, will be undertaken.

The anticipated dredging rate would generate approximately two to four barges per day, depending on whether one or two dredges were operating and the size of the barges. Thus barge traffic should not noticeably impede normal ship traffic. Interference with navigation would be minimized by coordination with the Coast Guard.

Impacts due to disposal of dredged materials are temporary since they do not permanently alter the substrate of the in-channel areas. Also, in-channel disposal impacts remain within the footprint of the dredging so that resource areas outside the navigation channels are not impacted except for temporary turbidity impacts.

During the 1½ year dredging process non-motile benthic organisms utilizing the disposal areas would be buried. Recolonization should occur within one year after disposal operations are completed based on the existing benthic population of early successional stage organisms. Fin fish would tend to avoid the area during disposal due to noise and turbidity disturbances. The benthos and fish would eventually recolonize the dredge site and will benefit from the removal of contaminated silts. Important anadromous fish populations would be protected by suspending dredging and disposal in the Mystic River during the running season.

The water column in the vicinity of the disposal site would experience increased turbidity following each disposal event. Approximately three to five percent of the silt/clay fraction would be lost to the environment during the disposal descent phase. Disposal simulation model evaluations indicated that disposal will not cause adverse exposure (i.e., exceedances of water quality criteria). Based on Total Suspended Solids (TSS), a turbidity plume has been calculated based on fate and transport modeling. It will not interfere with fish passage and migration. Use of mitigation measures, such as silt curtains, to contain suspended solids and associated chemicals, are proposed as additional safeguards to minimize water quality impacts in the Harbor.

Secondary impacts of the project, consisting of land-side infrastructure impacts, Harbor traffic, and other socioeconomic interests, are minimal. The BHNIP is not expected to increase vessel traffic in the Harbor but will enhance navigational safety and maintain the competitiveness of the existing Port. Vessel traffic will continue to include a mix of large container ships, barges and tankers. The Seaport Access system, which is part of the Central Artery/Tunnel project, will result in more direct and convenient connections for trucks between port terminals and the regional highway network, thereby reducing traffic impacts on local neighborhoods. This roadway system is independent of the dredging project.

8.1.3 Specific Impacts and Mitigation Measures

Chapter Six of the FEIR/S provides a thorough description of the primary, secondary and cumulative impacts of the proposed project and the specific mitigation measures provided to minimize the impacts. The following subsections discuss each of the major impacts identified in the FEIR/S and the applicable mitigation proposed.

8.1.3.1 Impacts to Harbor Bottom

Dredging of the BHNIP will remove contaminated silt from approximately 320 acres of Harbor bottom. Disposal of the silt material will consist of placing the material in 54 cells excavated into the uncontaminated parent material. These cells occupy approximately 116 acres within the 320 acres impacted by dredging. The disposal cells will be capped by clean granular material to provide a substrate for re-establishment of the benthic population temporarily displaced by the dredging and disposal. Removal of contaminated silt and replacement of contaminated silts with clean substrate mitigates the impacts to the Harbor bottom.

8.1.3.2 Water Quality/Sediment Quality

Material suspended during the dredging process is principally restricted to the silt or clay fraction of the material with sand particles settling out immediately after suspension. Grain size analysis of 18 stations within the Channels identify the substrate as 86.5% clay and silt, 11.2% sand and 2.3% rock. Chemical oxygen demand from the suspension of silts is expected to be low to moderate. Biological oxygen demand may be temporarily impacted from increased turbidity. Water quality modeling results conclude that under continuous disposal at the in-channel locations, no constituents were found to exceed chronic water quality

criteria if no more than 6,000 cy per day. Modeling of an instantaneous release scenario did not indicate any exceedance of chronic water quality criteria.

The use of an environmental closed bucket, and the application of silt curtains around the disposal cells, will mitigate for any temporary impacts to water quality from the dredging and disposal operations. Operational controls restricting the amount of material disposed per day, or disposed only at appropriate tides, will also be made part of the dredging operational control plans. Impacts have been determined to be short-lived, localized and controllable through standard dredge management practices.

8.1.3.3 Biological Resources

The primary impact of dredging will be the removal of benthic organisms inhabiting the 320 acres to be dredged. The dredging will cause a short-term loss of benthic productivity that will be rapidly offset through faunal recolonization demonstrated by Boston Harbor studies. Removal of contaminated silts over the dredged area would improve the maximization of faunal recovery. Dredging could also mask chemical signals used by migrating fish. This impact will be avoided by scheduling dredging so as to not coincide with migratory fish passage. Fish and invertebrates will be impacted in the short-term by blasting activities proposed for small sections of the BHNIP. Fish deterrence devices, such as sonic blasts or bubble screens, will be deployed to minimize fish mortality from blasting.

Disposal activities will have little or no effect on downstream Harbor fauna since they are characterized as tolerant to stresses associated with fluctuating turbidity levels and dissolved oxygen reduction. The use of silt curtains will minimize the downstream impacts, if any, on Harbor fauna.

8.1.3.4 Operational Controls, Contingencies and Mitigation

Impacts associated with the field operations of dredging and disposal were described in Chapter Five of the FEIR/S. Operational controls and mitigation strategies have been incorporated into the project design. These operational controls are:

- Capping the disposal cells with sand to maximize the potential for faunal recolonization with rock armoring in areas subject to vessel prop wash scouring;
- Scheduling of dredging and disposal to fit environmental window and to meet water quality criteria
- Coordinating with the U.S. Coast Guard to avoid interference between BHNIP activities and commercial traffic
- Scheduling activities to avoid peak recreational Harbor usage (4th of July, other holidays)
- Identification of significant structural features (bridge abutments, utility lines, bulkheads, moorings and buoys) to avoid negative impacts

- Imposition of dredging performance standards to meet environmental and permitting conditions as well as design controls

- Use of environmental bucket to trap contaminated sediments during dredging and outfitted with a sensor to detect closure problems due to debris

- Use of silt curtains during disposal

- Requirement for contractor to provide an incident response plan to cover spills of dredged material, fuel and machinery oil

- Trash and debris management on separate scows with agreements to dispose of materials in landfills

- Contingency plans for reasonably foreseeable equipment failures, weather conditions, encounters with buried structures, and permit limit exceedances

- A recognition that the Corps will make parent material available for beneficial use

- A recognition that the in channel sites will be monitored by the Corps under the DAMOS program.

8.1.3.5 Resource Enhancement Activities

Based on the data provided in the FEIR/S, the preferred alternative will not require compensatory resource mitigation. As local sponsor, Massport is willing to work with state resource agencies to identify resource enhancement opportunities in the Harbor area. As examples these can include working with state and local resource agencies to identify potential resource enhancement options such as supporting the development of an "urban fishing park" through rehabilitation of water access structures to enhance pubic use and access to functional recreational fishing areas. In addition, Massport is willing to work with appropriate agencies to increase the number of vessel sewage pump-out facilities in the Harbor Area.

8.1.4 Findings

For the reasons stated above, Massport finds that, with implementation of the operational mitigation measures described, all practicable means and measures will be taken to avoid or minimize adverse impacts to the environment relative to Massport actions. It is anticipated that appropriate conditions will be included in environmental permits to be issued by the DEP to ensure implementation of said measures.

8.2 MODEL SECTION 61 FINDING FOR DEP AGENCIES

The BHNIP project will require permits and approvals from the following DEP agencies:

- Massachusetts Department of Environmental Protection
  - Water Quality Certification
  - Division of Wetlands and Waterways review of local Order of Conditions

- Massachusetts Office of Coastal Zone Management
  - Coastal Zone Consistency Review

The following paragraphs provide a detailed outline of how the BHNIP complies with DEP regulatory policies for their permits.

8.2.1 Massachusetts Wetlands Protection Act (MGL c. 131, § 40 and 310 CMR 10.00)

The entire aquatic portion of the BHNIP will occur within the Mystic River, Chelsea Creek, East Boston and South Boston DPA's and as such, must address only one significant resource (land under ocean) relative to the Act and Regulations. This limits protectable interests to storm damage prevention and flood control, and the protection of marine fisheries. To comply with these interests, the BHNIP must fulfill specific applicable performance standards. The BHNIP fulfills these requisite conditions in the following manner:

1) Dredge channel and port area so that all portions of them will be adequately flushed by the tides.

BHNIP Compliance:

The proposed channel deepening should not alter the flushing rate of Boston Harbor appreciably, given the 150 billion gallon plus diurnal tidal prism that currently exists.

2) Complete the dredging operation as quickly as possible by using the most efficient and practical equipment.

BHNIP Compliance:

The proposed navigation improvement dredging is scheduled to occur over a 12 to 18-month time frame. Mechanical Dredging with limited blasting has been selected as the most feasible method to complete the BHNIP. An environmental bucket, determined to be the most feasible and least environmentally damaging methodology to dredge contaminated material, will be used to remove the silts.

3) Where possible, schedule dredging so as not to conflict with fisheries use.

BHNIP Compliance:

As required by regulation, the BHNIP will avoid any construction or disposal activity during the period of March 15 through June 15. In addition, the turbidity plume for the in-channel locations does not impede fish passage in any of the Channels

4) Bottom sediment analysis and evaluation of dredging should be coordinated with the DWPC.

BHNIP Compliance:

As stated in the DEIR/S, and based on the 3 tier analyses, the 2.9 million cubic yards of dredged material from the BHNIP will consist of approximately 1.7 million cubic yards of "clean" parent material including rock. The remaining 1.1 million cubic yards of silty material has been determined to be contaminated. Therefore, the BHNIP accepts the finding that all of the silt material is considered to be unsuitable for unconfined open water disposal. Further, all bulk chemistry, bioassay and biological evaluations have been planned and coordinated with federal and state regulatory authorities. Extensive water quality modeling studies have been performed for the in-channel options. Results indicate that the option meets DWPC regulations.

5) Minimize the amount of dredging.

BHNIP Compliance:

The Full Project is the preferred, and congressionally-authorized alternative for the dredging project. In addition to the removal of all unconsolidated silts required for maintenance, parent material would be dredged to project depths. The purpose and need for the Full Project has been documented in the FEIR/S. It offers the greatest benefits to the Port of Boston. The impacts associated with the dredging are temporary. In the absence of improvement dredging, maintenance dredging of the channels and berths would be required to maintain navigational safety. The maintenance material, or silt, is the contaminated portion of the BHNIP dredged materials. Issues regarding silt dredging and disposal, are therefore, issues that require resolution regardless of the improvement project.

6) Whenever possible, channel axis should not be parallel to direction of major storm waves.

BHNIP Compliance:

The BHNIP is limited to the existing channel configuration.

7) Wave height at any point along the shoreline shall not increase by more than 10% by disposal of dredged material on nearshore areas of land under ocean.

BHNIP Compliance:

The BHNIP will not significantly alter surface water hydrology within the project area.

8) Dispose of spoil in discontinuous bands, interrupted at least every 250 ft. by 50 ft. breaks to provide for passage of water, nutrients and aquatic life.

BHNIP Compliance:

This does not apply to the BHNIP since disposal of the silt materials will occur and be sequestered within the in-channel cells.

9) Dredged material disposal on any portion of land under the ocean shall have a mean grain size distribution which does not differ from the existing land under the ocean sediment grain size by more than 50%.

BHNIP Compliance:

No dredge material disposal will occur on any unpermitted or undesignated land under the ocean. In-channel disposal will be fully contained, sequestered and capped beneath granular substrate material.

10) Disposal of dredged material should avoid eel grass beds to the maximum extent possible.

BHNIP Compliance:

There are no eelgrass beds located at the in-channel sites.

11) Sedimentation or catch basins as appropriate to the amount of runoff.

BHNIP Compliance:

Not applicable to the BHNIP project.

12) All drainage structures should have gas traps, with appropriate maintenance.

BHNIP Compliance:

Not applicable to the BHNIP project.

13) Headwall and supports must be spaced so that sediment transport is not interrupted.

BHNIP Compliance:

Not applicable to the BHNIP project.

14) Space piles as far apart as practical for the structures being built, in no case less than 10 feet apart.

BHNIP Compliance:

Not applicable to the BHNIP project.

15) Construction shall be completed as quickly as possible to minimize the amount of turbidity and sedimentation.

BHNIP Compliance:

The BHNIP should be completed over a 12-18 month timeframe with dredging and disposal within the same footprint so that minimal additional areas would experience turbidity and sedimentation impacts.

8.2.2 Massachusetts Waterways Licensing Program (MGL c. 91 and 310 CMR 9.00)

While Massport is exempt from the requirement of an individual license, individual private berth owners are not. The BHNIP complies with c. 91 performance standards in the following manner:

1) Unless the project is located in a DPA, no dredging of channels, mooring basin, or turnarounds should occur below a mean low water depth of 20 ft. unless the waterway serves a commercial navigational purpose of jurisdictional significance and cannot be relocated to a DPA.

BHNIP Compliance:

The entire dredging and dredged material disposal program is situated in the Mystic River, Chelsea Creek, East Boston, or South Boston DPA's.

2) The design and timing of dredged material disposal activity shall be such as to avoid interference with anadromous/catadromous fish runs. At a minimum, no such activity shall occur in such areas between March 15th and June 15th of any year, except upon a determination by the Division of Marine Fisheries (MADMF) that such an activity will not obstruct or hinder passage of fish.

BHNIP Compliance:

The BHNIP avoids any construction/disposal activities during the period of March 15 through June 15.

3) The design and timing of dredging and dredged material disposal activity shall be such as to minimize adverse impacts on shellfish beds, fishery resource areas, and submerged aquatic vegetation.

BHNIP Compliance:

Given the nature of the current water and sediment quality of the project area, the opportunistic character of the benthic biota, and the lack of aquatic vegetation; the BHNIP does not permanently impact any of these biological resources. Any

disturbance or displacement will be temporary, and the sediment quality of the post dredge substrate will be clean granular material.

4) Outline operational requirements for dredging and dredge material disposal, for review and approval.

BHNIP Compliance:

Chapter Five of the FEIR/S provided a comprehensive Dredge Management Plan outlining all proposed operational requirements that satisfy this performance standard.

5) Provide appropriate supervision of dredging and dredge material disposal.

BHNIP Compliance:

Chapter Five of the FEIR/S provided a comprehensive Dredge Management Plan, and details all proposed supervision and construction management plans sufficiently to meet this performance standard.

8.2.3 MCZM Policies Applicable to the BHNIP

1) Policy 1 states, "Protect ecologically significant resource areas (salt marshes, shellfish beds, dunes, beaches, barrier beaches and saltponds) for their contribution to maritime productivity and value as natural habitats and storm buffers."

BHNIP Compliance:

The BHNIP dredging and disposal plans will not impact resources identified in this policy.

2) Policy 4 states, "Condition construction in water bodies and contiguous land areas to minimize interference with water circulation and sediment transport and to preserve water quality and marine productivity..."

BHNIP Compliance:

Dredging and material disposal activities should have minimal temporary effect on water quality, marine productivity, and the designated fish runs. Appropriate scheduling of activities during periods of low productivity and environmental dormancy should serve to minimize adverse effects to biological resources. The in-channel disposal and sequestering of contaminated silts, and the disposal of clean parent material at designated and approved disposal sites, should help to balance both water and sediment quality. Also, biological resources will naturally re-establish themselves in the post project condition. Re-colonization is expected after one year following disposal.

3) Policy 5 states, "Ensure that dredging and disposal of dredged material minimizes adverse effects on water quality, physical processes, marine productivity and public health".

BHNIP Compliance:

Since the channel bathymetry will not be significantly lowered in the post dredging condition, there should also be no increase in flood erosion hazards or adverse effects on natural replenishment of beaches. Given the nature of the project area shoreline, sediment transport is not very significant within the project area. Turbidity will be a short-term phenomenon, and should pose no long

lasting adverse effects. Contaminant stripping during dredge and dredge material disposal should be controllable. No chronic water quality thresholds will be exceeded during either continuous or instantaneous loadings, provided daily disposal volumes do not exceed 6,000 cy/day.

4) Policy 7 states, "Encourage the location of maritime commerce and development in segments of urban waterfronts designated as port areas. Within these areas, prevent the exclusion of maritime dependent industrial uses that require the use of lands subject to tidelands licenses."

BHNIP Compliance:

All facets of the dredging and dredge material disposal proposal are consistent with the DPA designation and consistent with existing usage. The deepening of the channel is necessary to make the DPA serviceable to the current shipping needs.

5) Non-Regulatory Policy 7, which deals with state financial assistance and direct state action states, "Encourage through technical and financial assistance expansion of water-dependent uses in DPA's and developed harbors, redevelopment of urban waterfronts and expansion of visual access".

BHNIP Compliance:

The proposed maintenance and improvement dredging is consistent with this policy.

8.2.4 Section 401 Water Quality Certification

The BHNIP must demonstrate that it complies with the 404(b)(1) guidelines (40 CFR 230.11) and 310 CMR 9.00 regulations for water quality certification. The following narrative demonstrates the BHNIP's compliance with these guidelines.

1) Physical Substrate Determination

BHNIP Compliance:

The BHNIP will remove both contaminated silt, clean parent material (clay), and/or rock from 320 acres federally designated channels and berthing areas exposing clean parent material (predominately clay with some ledge) throughout the project area. The resultant substrate should be clean and representative of the natural harbor substrate. Existing silts appear to be the result of continuous point and non point discharge to the Boston Harbor Environment.

In-channel disposal of the contaminated silt material will provide in-situ disposal opportunity of dredge material. The capping of the in-channel cells with the BHNIP parent material and/or sand would also provide suitable clean post-project benthic substrate. The disposal and sequestering of the silt material within the in-channel cells should provide an overall improvement in substrate conditions.

2) Water Circulation, Fluctuation and Salinity Determination

BHNIP Compliance:

The channel deepening and proposed dredge material disposal program will not alter the existing hydrology, flushing rate tidal prism.

3) Suspended Particulate/Turbidity Determination

BHNIP Compliance:

The dredging of the channel and berth areas will be performed in a manner to minimize the possibility of sediment release. A review of the levels of sediment chemistry, the ambient water quality and the use of an environmental bucket, indicates that a low potential exists for substantial degradation of ambient water quality during dredging.

Several factors may affect the characteristics of turbidity plumes associated with the project, including the discharge rate, character of the dredged material slurry, water depth, hydrodynamic regime, and the discharge configuration. Typically, the quantity of material re-suspended in the upper water column ranges from 1-5% of the total amount released.

The BHNIP modeling analysis presented in the FEIR/S indicates that no chronic water quality thresholds will be exceeded during either continuous or instantaneous loadings, provided daily disposal volumes do not exceed 6,000 cy/day.

4) Contaminant Determination

BHNIP Compliance:

The BHNIP modeling analysis included in the FEIR/S indicates that no chronic water quality thresholds will be exceeded during either continuous or instantaneous loadings, provided daily disposal volumes do not exceed 6,000 cy/day.

In-channel disposal, as proposed, concentrates both dredging and material disposal operations within the BHNIP footprint. This will minimize the project area and impacts involving additional remote sites.

5) Aquatic Ecosystem and Organic Determinations

BHNIP Compliance:

The Harbor benthic faunal communities are dominated by opportunistic deposit feeders. The Harbor is inherently stressful to benthic populations due to low DO levels and sediment contamination. The removal of this assemblage of organisms during dredging will have minimal impact on the ecological productivity of the Harbor as a system.

The dredging of the channel will cause a short term loss of benthic productivity that will be rapidly offset through faunal recolonization. Fishery resources associated with the Mystic River, Chelsea Creek and Inner Confluence are moderately significant based on a fisheries survey reported in the FEIR/S as Appendix E.

The Mystic River catch was dominated by winter flounder, atlantic tomcod and scup. The Chelsea River catch was also dominated by winter flounder and atlantic tomcod. At the Inner Confluence, the dominant catch species was winter flounder. These findings are comparable with previous finfish surveys in the area.

Chemical signals essential for anadromous fishery migrations could become masked by the dredging operation's suspension of sediments and associated chemicals. Dredging will be scheduled in non-sensitive areas of the Harbor and during appropriate periods to avoid impacting

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seasons of critical spawning runs of those species.

Sediment suspension will also displace motile species that will attempt to avoid gill abrasion, lower DO levels, and reduced sensory opportunities for predation (masked odors and low visibility) in the dredging area. These would be temporary and the effects would not have long-term detrimental impacts given the recommended mitigation practices.

Downdrift harbor fauna should be tolerant to stresses associated with fluctuating turbidity levels and DO reduction. Locating the material disposal locations within the dredging footprint limits stresses associated with the BHNIP from being exerted on remote communities. Most of the episodic effects on all biological resources will be triggered by the dredging itself. Motile organisms should evacuate the sites before and after filling or habitat displacement takes place. Sessile organisms will be lost.

Species of marine mammals which may occur in tidal waters in the vicinity of the project area, include harbor seals *(Phoca vitulina)*, harbor porpoises *(Phocena phocena)*, and grampuses *(Grampus griseus)*. However, their presence in the Boston Harbor system is uncommon. Since most of the dredging impacts will occur well within the Inner Harbor where marine mammals are uncommon, the project will not cause adverse impacts to these species.

The intertidal and subtidal areas, including and adjacent to the Federal channel area, are not known to provide habitat for any Federal threatened and/or endangered species, or State rare species. Letters from the U.S. Fish and Wildlife Service, the National Marine Fisheries Service and the State Natural Heritage Program have confirmed the lack of any threatened, endangered, or rare species in the area.

6) Disposal Site Determinations (Mixing Zone)

BHNIP Compliance:

For the in-channel site, the mixing zone will extend over several acres. Based on hydrographic variations, the following spacial extents were reported in the FEIR/S:

Mystic River: 12.4 acres
Chelsea Creek: 30.0 acres
Inner Confluence: 14.7 acres

Data reported in the FEIR/S and technical appendices indicate the mixing zone will not impact or impede fishery migration.

8.2.5 Findings

For the reasons stated above, the DEP finds that, with the implementation of the operational mitigation measures decribed, all practicable means and measures will be taken to avoid or minimize adverse impacts to the environment. It is anticipated that appropriate conditions will be included in DEP permits to ensure implementation of said measures.

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ATTACHMENT 1:

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES EVALUATED FOR POTENTIAL DREDGING AND DISPOSAL SITES

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ATTACHMENT 1:
AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES EVALUATION AT POTENTIAL DREDGING AND DISPOSAL SITES

1.0 INTRODUCTION

The purpose of this Affected Environment and Environmental Consequences Evaluation is to provide more detailed descriptions of dredging sites and potential disposal sites, as summarized in Sections 2.0, 3.0 and 4.0 of this Environmental Impact Report/Statement (EIR/S). Described herein are the baseline environmental conditions, proposed site uses and potential environmental consequences from dredging or disposal at each site. This evaluation is designed to provide a description of both the "existing conditions" and "environmental consequences" at the potential sites, in accordance with the MEPA EIR and Federal EIS guidelines.

Although the full project, in its entirety, is sponsored by Massport, the dredging activities (and sites) are broken down into two components:

1) Federal Project: This includes deepening portions of the federal channels to 40 feet including areas within the:

- Mystic River
- Chelsea Creek (to-38 feet MLW)
- Inner Confluence
- Main Ship Channel
- Reserved Channel

This portion of the project is being administered by the Army Corps of Engineers-New England Division (ACOE NED).

2) Non-federal Project: This includes the dredging of several berth areas throughout the Inner Harbor, Mystic River, Chelsea Creek, and the Reserved Channel. This portion of the project is administered by Massport and includes the following sites:

- Prolerized
- Distrigas
- Moran
- Mystic Piers
- Eastern Minerals
- Gulf Oil
- North Jetty
- Army Base
- Boston Edison Intake
- Boston Edison Barge Berth
- Conley

The project is described in Section 2.1, Volume 1 of the EIR/S. This evaluation focuses on the environmental conditions and impacts at the disposal sites.

2.0 ENVIRONMENTAL EVALUATION: DISPOSAL SITES

As part of this EIR/S process, an extensive site screening process (Section 3.0 in EIR/S) was undertaken to identify potential disposal sites for this project's dredged material. As a result of this process, 24 candidate sites were deemed potentially suitable for material disposal. They are grouped according to site type as follows:

Land-Based Coastal Sites
Squantum Point (QUI-03)
Everett (EVR-04)

Land-Based Inland Sites
Woburn (WOB-11)
Wrentham (WREN-495)
Plainville Sanitary Landfill
Fitchburg/Westminster Sanitary Landfill
BFI-Northern Disposal, Inc. (East Bridgewater)

Aquatic Sites
In-Channel Disposal (3 sites)
Subaqueous Containment Site B
Subaqueous Containment Site E

Nearshore Aquatic Sites
Mystic Piers (Massport 49 & 50)
Revere Sugar
Amstar
Cabot Paint
Little Mystic Channel
Reserved Channel

Borrow Pit Sites
Spectacle Island Confined Aquatic Disposal (CAD)
Meisburger Sites 2 and 7

Existing Open Water Sites
Massachusetts Bay Disposal Site
Boston Lightship Disposal Site

Locations of these potential sites are shown in Figure A1-1 and presented in more detail on figures contained in the following sections. The sites are described generally in the order given above; their order has no bearing on their status as an acceptable or preferred alternative.

The environmental evaluation process included a review of previous environmental studies and reports followed by site investigations to supplement and fill primary data gaps. Field groups comprised senior scientists in disciplines such as wetland ecology, wildlife ecology, marine ecology, estuarine ecology, water quality planning, and engineers experienced in environmental issues at landfills, materials disposal, site drainage, and site planning. During the in-field site investigations, these experts recorded their findings for baseline environmental conditions for each candidate site.

This evaluation examines impacts to each potentially sensitive resource at each of the candidate sites. Summaries of project impacts at each candidate site are presented in Section 3.0 of the EIR/S.

2.1 SITE EVALUATIONS: LAND-BASED COASTAL SITES

2.1.1 Squantum Point (QUI-03)

2.1.1.1 Existing Conditions

The Squantum Point site is located at the tip of Squantum Point in the City of Quincy (Figure A1-2). Formerly the Squantum Naval Air Station, the site is 44 acres in total area, however the eastern portion of the site has been developed into a staging point for the Deer Island wastewater treatment facility. The available area for the BHNIP containment facility is approximately 32 acres. The 100-year floodplain is 11 feet above MSL.

GEOLOGY/SOILS

The site appears to consist of historic tidelands that were filled for the construction of a small naval air station. The area is generally flat and surrounded on the shoreline perimeter by an eroded and dilapidated metal and concrete seawall. Soils in the project area are primarily Udorthents, which are classified as areas filled with excavated materials (SCS 1989a). Thickness of material is generally six feet or more, although the actual depth of fill at this site is unknown.

The type of bedrock underlying the site can only be inferred since no outcrops of bedrock are evident. Based on the mapping by Kaye (1980) this area may be underlain by conglomerate or by tuffaceous sediments. Depth to bedrock is unknown.

HYDROLOGY/WATER QUALITY

The hydrology of the site is not fully understood and is complicated by remains of the old airport's storm drain system (observed during site walks by project staff in November 1990 and May 1993). After a heavy rainstorm, water was observed in small pools in the upland

areas, while the wetland did not appear to be storing any runoff. Closer observation revealed a graded storm drain on the edge of the wetland and an outfall pipe to Dorchester Bay that, at that time, was clearly discharging water. It is not known whether the wetland was the sole source of this storm water flow or if other storm drains contributed as well. Water in the wetland drain was later observed to have reversed direction, flowing back into the wetland. This indicates that the wetland area is hydrologically connected to Dorchester Bay and influenced by tides, although the wetland plant community reflects only mildly brackish conditions. The erosion behind the decayed seawall indicates that overland flow to the bay does occur, although the erosion is in part due to tide and wave action.

No information concerning groundwater resources at this site was available. However, groundwater appears strongly influenced by tides and could be highly saline. Any groundwater at this site would not be suitable for public water supply.

The Neponset River and Dorchester Bay are both classified as SB by the Massachusetts Department of Environmental Protection (MADEP), in the surface water regulations (314 CMR 4.00). This classification protects saline water bodies for the following uses: propagation of fish and aquatic life and wildlife, primary and secondary contact recreation, and shellfish harvesting with depuration. Abundant shellfish beds are present in the tidal flats off Squantum Point as noted during a site visit in October 1990. However, as these shellfish cannot be reliably depurated, Massachusetts Department of Marine Fisheries (MADMF) has closed the area for harvesting except for bait (Ralph Stevens, MADMF, 1993, personal communication).

Limited water quality data are available for the Neponset River at its confluence with Dorchester Bay; however, water quality in the river is likely influenced by combined sewer overflows (CSOs) and non-point source pollution (NAI 1990). Historical data have shown high variability in fecal coliform concentrations at the mouth of the Neponset River (NAI 1991a). Bacteria and dissolved oxygen are likely the two most limiting factors on water quality in Dorchester Bay, although a complete assessment of water quality cannot be made at this time.

AQUATIC RESOURCES

There are no freshwater streams or ponds on the Squantum Point site, although several depressions may intermittently retain surface water.

Marine resources are influenced by conditions in both the Neponset River and Dorchester Bay. Thus, although the intertidal area is broadly defined as tidal flat with a fringing, patchy salt marsh, substrate conditions vary dramatically, depending on exposure. The following description of intertidal communities is based on studies performed by NAI in 1990. Physical conditions appeared little changed in subsequent site visits by NAI in May 1993.

The intertidal zone was narrowest (65 feet) in the easternmost portion of the site, broadening to more than 1000 feet at the northwest corner. Salt marsh vegetation was patchy and best developed along the western side of the parcel. Sediments in the upper intertidal zone were predominantly sand, grading to pebbles and then silty sand within about 50 feet of the bulkheaded shoreline. At the northern end of the point, sandy sediments extended 100+ feet from the shoreline. Seaward, sediments were silty sand/sandy silt with large quantities of shell hash. There were extensive blue mussel (*Mytilus edulis*) beds in the lower intertidal zone along much of the northern border of the site.

Dominant benthic infauna of the northerly exposed tidal flat included the spionid polychaetes *Streblospio benedicti*, *Polydora cornuta* and *Pygospio elegans*; oligochaetes; soft-shell clam spat (*Mya arenaria*); and nematodes (NAI 1990). These species typically exhibit wide temporal fluctuations in abundance but represent potentially important food resources for higher trophic levels because of their high abundances. These same taxa were also abundant in the areas of intertidal sandy beach. The additional prevalence of the longer-lived maldanid polychaete *Clymenella torquata* in the beach community suggests that environmental conditions have exhibited consistent patterns in the recent past, allowing the establishment of a stable benthic community. A microfloral community appeared to be established along the north-facing tidal flat. The chlorophyll *a* concentrations indicated a moderate to high potential for utilizing nutrients contributed by the Deer Island treatment plant and other sources (NAI 1990).

The intertidal substrate along the western border of the site was primarily fine-grained sediments with large quantities of shell hash. Salt marsh broadened from about 5 to 15 feet moving south along the site. Mussel beds were extensive about 600-700 feet offshore. The benthic community along the western boundary of Squantum Point exhibited the typical opportunistic dominants, spionids and oligochaetes, as well as abundant soft-shell clam spat. Less abundant taxa add to the diversity and food-resource value of the flat (NAI 1990) and contribute substantially to the biomass available for consumption by foraging fish, megainvertebrate fauna and shorebirds. The sediment surface yielded high values for chlorophyll *a* (NAI 1990).

The tidal flats were described as productive clam beds by Chesmore et al. (1971). There continues to be a large soft-shell clam population in this area, averaging 16.5 clams/ft^2 (NAI 1990). Clams were sparsest along the northern boundary and most abundant at the northwest corner. Mean size was 5.3 cm with 62% of the clams being larger than 5 cm (harvestable size). Presently, harvesting of shellfish is prohibited except for bait because of contamination (Ralph Stevens, MADMF, 1993, personal communication). Live razor clams (*Ensis directus*) were also observed.

The blue mussel beds were dense aggregations with abundances averaging 58/ft^2, and over 90% alive (NAI 1990). Benthic infauna were very abundant in the vicinity of the mussel beds. Unlike the other parts of the intertidal zone, the mussel beds supported a variety of arthropods (mostly amphipods) and other mollusks, with soft-shell clams being numerically dominant. Dominant annelids were the same ubiquitous taxa. Few burrowing species were represented. Chlorophyll *a* values were moderate to high.

Finfish and epibenthic fauna were not investigated. The abundance and diversity of habitat available for benthic infauna indicate the suitability of the Squantum Point intertidal zone to provide trophic support for these consumers. Species such as green crabs (*Carcinus maenas*) and other crabs (*Cancer* sp.) are likely to forage among the mussel beds and open tidal flats and, in turn, be preyed upon by wading birds. Flounder and other demersal fish, particularly juvenile stages, use intertidal areas extensively for feeding. The MADMF officially recognizes the Neponset River as a spawning run for rainbow smelt. MADMF considered the anadromous

fishery resource of the Neponset River to include a large smelt run, a limited shad run and a river herring (alewife and blueback) run (MADMF 1990, personal communication).

An area of potential concern in the vicinity of the Squantum Point site is a bed of submerged vegetation in the Neponset River that extends from Commercial Point to an area beyond Tenean Beach (MWRA 1987). The extent and character of this resource has not been determined.

The Squantum Point intertidal area was rated as having a high potential for aquatic diversity and abundance and a moderate-to-high potential for nutrient retention/transformation (NAI 1990). The extensive shellfish beds around the entire flat and fine sediments on the western shoreline suggest a high potential for sediment/toxicant retention. This site has a high potential for shellfish habitat as indicated by the variety of substrate conditions and mollusk species present. The large food resources in this tidally influenced area indicate a moderate-to-high potential for providing fish habitat. Similarly, the tidal flat resources are potentially important for migratory shorebirds. The breadth of the intertidal area offers sediment and shoreline stabilization, although the open exposure to the north and erosion behind the sheetpile wall indicate that storm tides reach the upland edge of the site.

VEGETATION

Random seed dispersal and tolerance of the degraded and artificial substrates remaining after past uses have influenced the type of vegetation that has developed on the site. Vegetation has not developed to the point of presenting well-defined classes with good structure and habitat, owing at least in part to the compacted fill substrate which serves as soil. Two broad upland vegetation classes currently exist within the confines of the seawall: early successional shrubland, approximately 10-15 feet tall; and old field encroaching on the abandoned runways and perimeter road.

Most of the site is covered by aggressive plant species, able to withstand disturbed conditions. The mixture of shrubs, grasses and forbs is dominated by sumac (*Rhus typhina*),

bayberry (*Myrica pensylvanica*), poison ivy (*Toxicodendron radicans*) and multiflora rose (*Rosa multiflora*), making foot travel difficult. Grass species include quackgrass (*Agropyron repens*), upland bent (*Agrostis perennans*) and broom beardgrass (*Schizachyrium scoparium*), while the forbs are predominantly Eurasian invaders, including wild carrot (*Daucus carota*), mugwort (*Artemisia vulgaris*), heath aster (*Aster ericoides*) and tansy (*Tanacetum vulgare*).

WETLAND RESOURCES

The on-site and adjacent wetland areas described herein were field delineated by NAI in 1990 using the 1989 federal identification methodology (NAI 1990) and are those areas estimated to fall within the review of Section 404 of the Federal Clean Water Act. Also documented are those associated wetland resource areas, identified from published references or by field observation, that are protected under the jurisdiction of the Massachusetts Wetlands Protection Act (MGL c 131, s 40) and its implementing regulations (310 CMR 10.00). These include: 1) Land Under the Ocean, 2) Coastal Beach, 3) Salt Marsh, 4) Land Containing Shellfish, 5) Fish Run, 6) Land Subject to Coastal Storm Flowage, and 7) Bordering Vegetated Wetland. Also present is a regulated buffer zone extending 100 feet inland and/or upland of the coastal beach, salt marsh, and bordering vegetated wetland.

During the 1990 wetland delineation, on-site construction activities associated with the Deer Island staging facility continuously changed terrestrial site characteristics. Therefore, the team of wetland scientists had problems clearly identifying on-site conditions. The 1993 site visit, however, indicated more stable conditions. Existing fill soils and transitional vegetation greatly complicate wetland delineation. Should Squantum be chosen for final design a comprehensive wetland resource evaluation and boundary delineation will be required using the current state and federally approved methodologies.

Several acres of salt marsh are found on Squantum Point, outside and adjacent to the seawall. These are interspersed with areas of tidal flat and coastal beach. The largest band of salt marsh lies on the northwest corner, outside the wall, and runs southward beyond the site. This salt marsh band consists almost entirely of cordgrass (*Spartina alterniflora*), with minor amounts

of sea lavender (*Limonium* cf. *nashii*) and seaside goldenrod (*Solidago sempervirens*), and has a substrate of sand and cobbles. The width of the marsh averages approximately 30 feet, with its upper limit coinciding with the high tide level. A strip of coastal beach approximately 10 feet wide included the apparent mean high tide line, above which beach grass (*Ammophila brevigulata*) dominated to the base of the seawall. Several small patches of salt hay (*Spartina patens*) were interspersed with beach grass.

Landward of the seawall, fills and disturbed surfaces dominate the area. The hydrology is very difficult to discern, owing to the presence of an old subsurface drainage system of unknown extent. At one culvert break along the northern wall, erosion has initiated a depression along 15 feet of the wall, now colonized by some beach and salt marsh species: cordgrass (*S. alterniflora*), reed (*Phragmites australis*), sea-blight (*Suaeda linearis*), seaside goldenrod (*S. sempervirens*) and saltwort (*Salicornia europaea*).

The northwestern shore supports a more patchy, irregular salt marsh which extended seaward from the base of the seawall. Dominated by cordgrass, this marsh was obviously situated in a high energy environment as indicated by the eroding peat on its seaward face, and the deteriorating condition of the seawall behind it.

A 1.0± acre brackish wetland with an ephemeral hydrologic connection with Dorchester Bay lies about 300 feet inside the seawall, and is surrounded by upland vegetation and soils. Appearing as an open herbaceous community, the plant species include a mixture of freshwater and salt-tolerant plants. It is dominated by red-top (*Agrostis alba*), rushes (*Juncus effusus* and *Juncus gerardi*), cattail (*Typha angustifolia*), three-square sedge (rush) (*Scirpus americanus*), purple loosestrife (*Lythrum salicaria*) and seaside goldenrod (*S. sempervirens*). This wetland drains to the northwest through a low-lying iron catch basin and culvert placed at such an elevation and slope that allows the highest spring and storm tides to back flow through the culvert, bringing salt water into the wetland's northwest corner. The wetland soil is mineral, and clearly hydric. It has some permeability but little or no organic content, as would be expected with recently formed soil. Immediately following a two-day, 2 to 4 inch rainfall, the wetland had no ponded waters, but the fill substrate was fully saturated. Approximately 0.1 cubic feet per second (CFS) was running out of the culvert. Other small areas of wetland may occur in slight depres-

sions among early-succession shrublands and would require delineation if this site were selected for final design.

In 1990, the inland wetland was evaluated using the Hollands-Magee freshwater wetland model (NAI 1990). Results indicated that the wetland had a very low hydrologic and structural diversity, resulting in low biological value. Scores for nine of ten wetland functional elements using the Hollands-Magee model rated below median; only aesthetics rated above median, mostly due to the abundance of showy flowering plants. This means that this wetland ranks below most New England inland wetlands in the NAI database for all the Hollands-Magee values other than aesthetics.

WILDLIFE

The old-field portion of the site is somewhat diverse, with an intricate mix of shrub and herb layers providing habitat/edge conditions. The shrub layers form an interconnecting network, providing habitat for numerous ground animals, including cover and food for small to medium-sized mammals and resident, migratory and wintering bird species. Observed on-site mammal species included: muskrat, house cat, mouse (evidence); and several bird species: common grackle, ring-necked pheasant, northern flicker, American goldfinch, song sparrow, eastern kingbird, gray catbird, American robin, yellow warbler and short-eared owl. The tangles of poison ivy and multiflora rose provide cover and food (e.g., berries) for many of these species. Small trees, such as red cedar and poplar, provide nesting places for birds with substantial height requirements (e.g., American goldfinch, eastern kingbird), whereas the rose-ivy tangles are excellent for low nesters (e.g., song sparrow: Harrison 1975). Animal movement into and out of the area is restricted mainly to urban species, aquatic species, and birds because of the site's isolation from other wild or open areas.

Little wildlife value can be attributed to the inland wetland community, due to the low food value of the plants and low value for cover. Outside the seawall, however, the mixture of salt marsh, beach and tidal flats provides extensive habitat for migrating and resident shorebirds. These interspersed resources, combined with the high diversity of marine invertebrates, provide

excellent food resources for birds such as turnstones, yellowlegs, sanderlings and smaller sandpipers. During field visits, double-crested cormorants were observed utilizing open water, with herring gulls, great black-backed gulls, ring-billed gulls, brant, greater yellowlegs, black-bellied plovers and mallard ducks in the beach and tidal flat areas.

THREATENED AND ENDANGERED SPECIES

The Massachusetts Natural Heritage and Endangered Species Program (MANHESP) records did not identify any protected species or habitats which occur on the site (MANHESP, letter dated March 1, 1993).

A short-eared owl was observed on-site during fieldwork on November 5, 1990. This owl is presumed to have been migrating from the more populated Canadian tundra breeding grounds or occupying a wintering ground at the time it was seen. Most short-eared owls in the east breed much farther north in open country and then winter from northern New England south to the Chesapeake Bay (Johnsgard 1988). This species may utilize any wet meadow habitat in the Boston Harbor area during the winter. The Squantum Point area is unlikely to provide suitable habitat for breeding, due to small size, urban setting and high present levels of disturbance. This species is listed by Massachusetts as an endangered breeding species. This species is of worldwide distribution. In New England, it is most commonly seen as a migrant and winter visitor in coastal fields, airports and salt marshes (Johnsgard 1988). It is known to actually breed in a very few locations in New England, mostly coastal. It prefers open grassland habitats where abundant small mammals are available as prey - especially meadow voles (*Microtus pennsylvanicus*). Brackish marshes connected to tidal flowage and wet grassland areas often have an abundance of such small mammals.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

Detailed information regarding historical and archeological resources on Squantum Point was obtained in 1990, when the site was under consideration for development (NAI 1990).

For that study, documentary research for assessing possible historical and archeological resources included consultation of the State Register of Historic Places, files and materials at the Massachusetts Historical Commission (MHC), the Quincy Historical Society and the Boston Landmarks Commission as well as insurance atlases and maps. Data on known prehistoric sites were collected from the MHC, interviews with local archaeologists and individuals, and cultural resource management reports. USDA soil surveys were examined for stratigraphic data. A site walk was conducted to locate surface cultural remains and to assess the archeological sensitivity of the site. The 1990 study and a follow-up file review at MHC in 1993 revealed no known historic resources on the site or its environs.

Approximately 11 prehistoric sites are recorded from the Squantum area. These sites include shell middens as well as dog and human burial areas, which primarily date to the Late Woodland, Contact and Early Historic periods. No sites are recorded for the project area.

SOCIO-ECONOMIC/LAND USE

This former naval air station, a 44± acre site, is now owned by the Metropolitan District Commission (MDC), which intends to build a waterfront park as funds become available. Part of the site is used as a ferry docking facility to transport construction personnel to Deer Island for the Boston Harbor Clean-up Project (reference). This facility includes parking for 930 vehicles. The ferry facility will be made available to the MDC upon completion of the construction of the sewage treatment plant at Deer Island. The remainder of the site is a mixture of paved area and shrubs. To the east of the site is the Village at Marina Bay, a mixed-use development including residences, a marina, offices, restaurants and shops.

Quincy has a long history, beginning as a prosperous farming community and the home of two Presidents. Major industrial facilities including the former Fore River Shipyard now line its coast along with residential uses. Much of the land area in Quincy is devoted to park use. The population of 86,182 is 90% white and 6% Asian. The median family income is $44,184. Higher-income households have settled in Quincy with the development of new housing in and adjacent to Marina Bay.

Access to the subject site is via I-93 south to Neponset Circle, Route 3A to Quincy Shore Drive, an MDC parkway and from there, to a connector road to Commander Shea Boulevard. Existing mudflats around Squantum Point presently constrain marine access, therefore dredging would be required.

2.1.1.2 Environmental Consequences

In several respects, Squantum Point would provide the most suitable disposal option of the short-listed land-based sites. With its estimated capacity of 210,000 cy, the site could potentially accommodate the entire volume that could be reasonably dewatered for land-based disposal; it is currently in a disturbed state due to the presence of the abandoned runways, underdrains, and seawalls; and can be accessed by barge, although some dredging would be required, which would eliminate trucking related difficulties. The major limitations of the site include the dredging impacts and the site's proximity to the residences of the Village at Marina Bay.

DIRECT IMPACTS

Permanent Loss

Direct impacts at Squantum Point would include the filling of the shrublands and abandoned runways of the site. Although disturbed, this area currently provides wild open space on a heavily developed harbor. No unusual wildlife are known to breed at Squantum Point, although a short-eared owl (a Massachusetts breeding endangered species) was observed on the site in November 1990. This individual was probably overwintering or migrating through, feeding on the mice and voles that are common in such areas. Filling the site would destroy the current habitat, making it unavailable to any species during the dredging phase of the BHNIP. With completion of the dredging, the containment facility would be capped and landscaped. If desired, the plantings could be done to provide some habitat improvement for target species (e.g., open

natural grasslands to attract birds of prey), thereby ultimately enhancing the site's ability to support wildlife.

Temporary Loss

Dredged material would most likely be delivered to the site via barge, requiring dredging of a 60-foot-wide channel from the Deer Island ferry channel to the northeast corner of the site. This dredging would impact approximately 1.4 acres (13,000 cy) of subtidal habitat, and 0.3 acres (6500 cy) of intertidal habitat, some of which may include a narrow band of salt marsh. Impacts to aquatic resources would include destruction of existing benthic communities in the dredged channel, although the new channel bottom, which would be an average of 6 feet deeper than present depths, would likely be re-colonized by benthic organisms similar to those impacted.

Permanent Alteration

Channel dredging in the 0.3± acre intertidal zone would result in the conversion of tidal flats and salt marsh to subtidal habitat. It is presumed that the tidal flats and salt marsh provide protection of wildlife habitat and of marine fisheries including shellfish. Other benefits include storm damage prevention, groundwater supply protection, flood control and pollution prevention. Primary functional losses would include a 0.3 acre reduction in migratory bird resting and feeding areas, intertidal productivity, water quality treatment and shoreline stability. Impacts to migratory bird habitat would include the permanent loss of the dredge channel area as well as temporary impacts in the vicinity due to disturbance from project activity. Loss of intertidal productivity would be greatest in the salt marsh area where primary productivity is highest. Nutrient transformation is significant in both tidal flat and salt marsh habitats, although the shallow subtidal dredge channel, when recolonized, would also perform that function to some extent. Shoreline stability would be affected by both loss of the buffering capacity provided by existing gentle grades, and the disruption of the erosion-resistant salt marsh peat that currently forms a continuous band along the northeastern (exposed) side of the site. Engineered protection

against storm-driven waves and long-shore currents or refilling the access channel after disposal would possibly be required to minimize erosion.

The freshwater wetland currently known to exist on the site would not be impacted, however, should this site be selected for disposal, the wetlands should be remapped because of the disturbances and changing hydrology of the site.

INDIRECT IMPACTS

Increased turbidity and redeposition of suspended sediments during the dredging process could cause temporary impacts to adjacent benthic communities.

Upon closure of the project, freshwater runoff would be directed via swales to outfalls on the north and west sides of the site. The outfalls would open at the concrete/sheetpile seawall, and runoff would then cross the bands of salt marsh. During storm events, freshwater flow across the intertidal zone could impact infauna by creating osmotic stress. This would be most significant for species whose recruitment period is limited, such as soft-shell clams. Adults can isolate themselves from short-term perturbations by retracting their siphons. Spat are located at the sediment surface. Those located in the runoff path could die if freshwater runoff coincided with low tide. Runoff would reach mussel beds only during major storm events, due to the location of this resource in the lower intertidal zone. This would likely be of little impact due to the animal's ability to seal itself off, and to the short duration of exposure in each tidal cycle.

Loss of productivity on the tidal flat would depend on the design of the outfall and quantity of flow. The overall ability of the tidal flat to support finfish and shorebirds could be reduced by the intermittent loss of productivity in the runoff path, both by benthic microflora and invertebrates. However, this would likely be a minor impact since only a relatively small portion of the flat would be affected. Other functions of the intertidal area would be little impacted.

GEOLOGY/SOIL

The placement of 935,880 cy of dredged material (predominantly silts) should not severely impact the previously altered site geology and soil conditions. These silts would not be placed in or on any existing resources (e.g., wetlands), and would be placed with appropriate containment (capping) and sedimentation/erosion controls.

HYDROLOGY/WATER QUALITY

Groundwater impacts are difficult to anticipate due to the complex drainage system currently underlying the site, but would be expected to be minor because of the likely dominance of marine hydrology. Surface water from runoff would be directed so as to minimally alter current hydrologic budgets of surrounding lands and tidal flats. The site's flat topography would naturally limit impacts from altered runoff patterns.

Because the quality of groundwater resources at this site is unknown, potential impacts cannot be fully addressed. However, a liner would be required by the MADEP and should minimize leachate contamination of the groundwater.

AQUATIC RESOURCES

No freshwater ponds or streams occur on the Squantum Point site, so there would be no impacts on these resources.

WETLAND RESOURCES

The avoidance of any filling or other activity directly affecting protectable resource areas was established as one of the design criteria for the containment facility. Therefore, impacts would be limited to dredging a barge access route, and are described in the previous section. A

detailed final investigation would be required to confirm that no other jurisdictional wetland resources occur in the shrub tangles on the site. No encroachment into the buffer zone associated with the Bordering Vegetated Wetland or Coastal Beach is proposed.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

Because there are no listed historical or archeological resources at or near the proposed Squantum Point site, no impacts are anticipated. However, the site is an artificially filled landform, and cultural or prehistoric resources could lie buried below. No adverse impact would be expected as long as no subsurface activity is conducted. If excavation were required, then machine-excavation with archeological monitoring would be recommended to determine the existence of potentially significant remains from either the Naval Air Station or small, isolated, intact prehistoric sites.

SOCIO-ECONOMIC IMPACTS

The site is proposed for development of a waterfront park by the MDC. Use of Squantum Point for dredged material disposal could delay and potentially alter these plans. Potential mitigation for loss of the planned park would be to design a park that would be compatible with the site after it was capped.

Odor and noise from the dredge disposal could affect residences and businesses in the Village at Marina Bay. Odor could be minimized by chemically treating or covering the disposal site daily with clean material. Noise impacts could be reduced by restricting usage during nighttime and other sensitive periods.

2.1.2 Everett (EVR-04)

The Everett site is approximately 23 acres in size in a "U" shaped parcel around a shallow inlet on the Mystic River (Figure A1-3). The Boston/Everett Corporate boundary bisects the parcel so that approximately two-thirds of the site lie in Everett and one-third in Boston. Boston Edison Company owns the Everett parcel. The Boston parcel is city-owned and currently has a MDC pumping station located on the southern side. This site discussion will focus on the 15-acre Everett parcel.

2.1.2.1 Existing Conditions

GEOLOGY/SOILS

Soils on the site consist primarily of Udorthents with a wet substratum. Udorthents are defined as fill soils over former tidal marshes, and other wetland resources (SCS 1989a, 1989b). The depth of fill ranges from 2 to 20 feet or more, with seasonal high groundwater ranging from 3 to 5 feet below the surface.

Based upon the mapping of Kaye (1980), the central portion of the site is underlain by bedrock consisting of sandstone or quartzite while the northern and southern portion of the site is underlain by sandstone argillite, with minor interbedded sandstone and/or quartzite. Bedrock has been mapped as outcropping near the site and the average depth to bedrock on site may be relatively shallow.

HYDROLOGY/WATER QUALITY

There are no surface waters on the site, so the hydrology is fairly simple. The topography of the site is flat, therefore most precipitation will infiltrate to the groundwater or be taken up through evapotranspiration. Any water that does run off most likely will run into the Mystic River.

The site consists of low-yield aquifers (<100 gpm) with half the site being classified as low and the other half as very low (MADEP Groundwater Overlay Maps). There are no wells on site or within 0.1± mile. Groundwater quality is influenced by tidal action and is probably saline in nature. Also, there are several hazardous waste sites near the site which may have an influence on groundwater quality. The site is not suitable as a drinking water supply. No data were available for groundwater quality at the site.

The Mystic River is classified as Class SC by MADEP. Waters under this classification are saline and designated for the protection and propagation of marine life and for secondary contact recreation. Water quality in the vicinity of the site is most likely influenced by several NPDES discharges into the Mystic River.

Water quality data for the Mystic River are available from sampling done by MADEP in 1982-1986 (Menzie-Cura and Associates 1991). Samples were taken downstream and near the confluence of Island End River. Results of this sampling indicate that the average concentrations for cadmium, copper, and lead exceeded the chronic criteria for aquatic life. The acute aquatic life criteria for cadmium, chromium, copper, lead, and zinc were exceeded on at least one occasion.

AQUATIC RESOURCES

The aquatic resources near the Everett site were not sampled; however, substrates appeared to be made up of fine-textured sediments in the exposed intertidal areas. It is likely that the subtidal communities are similar to those observed in the Mystic River and pier areas of Mystic Piers, Revere Sugar, and Amstar (as detailed in later sections). The intertidal areas may support soft-shell clams (*M. arenaria*), but are likely to have small populations due to the fine-textured substrates.

VEGETATION

The upland portion of the site is flat and dominated by early-successional grasses, forbs and scattered saplings. Plant cover is sparse on approximately 50% of the site, where gravel and old asphalt dominate. These areas have poor quality rooting substrates and also appear to be periodically used by vehicles entering the site. The remainder of the site has better herbaceous cover: dominant species include several clovers (*Trifolium* spp.), grasses including broom beardgrass (*Schizachyrium scoparium*), mugwort (*Artemisia vulgaris*), goldenrods (*Solidago* spp.), milkweeds (*Asclepias* spp.) and bird's foot trefoil (*Lotus corniculatus*). Scattered saplings of cherries (*Prunus* sp.), trembling aspen (*Populus tremuloides*), gray birch (*Betula populifolia*), and staghorn sumac (*R. typhina*) occurred across the site, and are most prevalent on the western leg of the parcel. This leg in general appeared to be less disturbed, with better herbaceous and sapling cover.

Common reed (*P. australis*) occurred in patches around the periphery of the inlet at the top of the bulkheads. Because the bulkheads appear to be well above the high tide line, and would not impound freshwater, these stands of common reed appear to be opportunistic, occurring in upland settings. One exception may be the seaward edge of a small stand in the northwest corner of the inlet. In this area the fill behind the bulkhead has collapsed and may be exposed to tidal inundation during exceptionally high tides.

WETLANDS RESOURCES

No delineation of jurisdictional resources was performed at Everett; however, areas of tidal waters will fall within the purview of Section 404 of the Federal Clean Water Act. Massachusetts jurisdictional resources ((MGL c.131, s.40, and 310 CMR 10.00)) on the site include coastal bank, tidal flats, coastal beach and land under the ocean. A 100-foot buffer area, inland of the top of the coastal bank occurs on the east and west portions of the site. Small areas of coastal beach and coastal bank occur along the seaward end of the east and west portions of the site. These resources are composed of eroding fill, and have been partially reinforced by boulders and rubble.

With the possible exception of the seaward edge of the common reed stand as described in the previous section, no vegetated freshwater wetlands occur on site. During the site visit, a pool of standing freshwater was observed in an asphalt depression in the northeast corner of the site. The lack of requisite soils and vegetation preclude this as a wetland.

WILDLIFE

The paucity of vegetation and the surrounding urbanization limit the value of the Everett site for terrestrial wildlife. Animals typical of urban settings, such as rock doves, European starlings, house sparrows, and house mice might use the site, as would birds that nest on bare ground, such as killdeer. The western leg of the site, which is somewhat more densely vegetated, also would support species typical of herbaceous or "old field" habitats: for example, common yellowthroat, song sparrow, and meadow vole (DeGraaf and Rudis 1986). A song sparrow was heard in this area during 1993 site visits.

The intertidal flats and river bordering the site would be of more value to wildlife than would the site itself. Herring gulls and great black-backed gulls were observed feeding on the intertidal flat between the inlet and Route 99 on May 12, 1993. On May 25, 1993, a black-bellied plover, a semipalmated plover, and a killdeer were observed foraging on the intertidal flat along the Mystic River on the southwest corner of the project area. Common terns, a Massachusetts Species of Special Concern (321 CMR 10.60) were observed courting and apparently nesting on the dilapidated pier on the western side of the inlet. While only pilings remained for most of the length of the pier, the outermost section remained intact and formed an isolated platform on which the birds were seen. A great black-backed gull, a potential nest predator, also seemed to be sitting on a nest on the same platform on May 12, but a gull observed on May 25 exhibited no nesting behavior.

THREATENED AND ENDANGERED SPECIES

MANHESP records indicate that no protected species or habitats occur on the site (MANHESP, letter dated March 1, 1993).

Common terns feeding and courting were observed near the Everett site during two site visits in May 1993. As stated above, the common tern is a Species of Special Concern in Massachusetts. Four terns were sitting on the dilapidated pier in the inlet on May 12. One was seen to stand and pull material on the ground closer to itself. This activity and the posture of the birds suggested that they were sitting on nests on the old pier. During a subsequent field visit on May 25, six common terns were observed to exhibit nesting behavior. Terns were also observed foraging in the Mystic River near the site.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources on the Everett site. A jackknife bridge was inventoried by MHC within 1000 feet upstream of the site. It has been for sale since 1990 and may have been dismantled (Mr. W. Smith, MHC, pers. comm.).

SOCIO-ECONOMIC/LAND USE

This site is a narrow basin abutting 28± acres of vacant land on the north side of the Mystic River in Everett. It is surrounded by industrial uses including a Boston Edison power station. A rail line abuts the western boundary of the site. There is a park and playground facility across Broadway and to the north of the site.

Everett was originally a territory of Charlestown, its neighbor across the Mystic River. A farming community for 150 years, Everett evolved into an industrial city with the advent of the railroads that facilitated transportation to Boston. Factories for brick manufacturing and the production of chemicals, located in Everett in the 19th century, have been joined by facilities for

metal product fabrication and machinery in the past 100 years. The predominant land use in Everett is residential. Everett's population of 35,701 is predominantly white with a median family income of $37,397.

Land access to the site is from I-93 to Sullivan Square in Charlestown, and traveling north on Route 99 (Broadway) across the Mystic River. The parcel surrounding the basin abuts Route 99 to the east. Mud flats extend along the Mystic River edges, making access for vessels difficult. Some dredging would be required to accommodate barges related to the material disposal project.

2.1.2.2 Environmental Consequences

Everett is the smallest of the land-based potential disposal sites with an estimated capacity of 55,000 cy.

DIRECT IMPACTS

Permanent Losses

The site is a vacant lot in an urban setting, and as such offers habitat for typical urban species such as song sparrows, rock doves, and house mice. Most of this habitat would be impacted with the construction of the containment facility, and the resident animals displaced or destroyed. Upon capping and closure of the project, its value as open space in an urban setting would be restored, and most of the species currently using the site should return.

The placement of dredge spoils and the proposed containment facility would eliminate all existing vegetation within the disposal footprint. Upon completion of all on-site activities, natural recruitment and early stage succession of tolerant and opportunistic species should occur.

Temporary Loss

The preferred route to the site would be via barge which would require dredging to deepen the inlet channel to reach the existing granite bulkhead. This would result in the loss of approximately 0.3 acres (2300 cy) of subtidal habitat. The dredging process would destroy any benthic communities in the dredging corridor, although it is likely that similar benthos would re-establish in the deepened channel. Existing depths average 5.0 feet MLW, therefore dredging an additional 5.0 feet would be necessary to achieve a final 10.0 foot channel depth. Turbidity and redeposition of suspended sediments could cause temporary impacts to adjacent benthic communities during the dredging process, although these communities would be expected to recover quickly following completion of the dredging.

A second possible approach for barge traffic would provide access from the western leg of the site. However, this would require dredging of 0.2± acres (5000 cy) of intertidal and 0.03 acres (200 cy) of subtidal habitats. This approach would also impact an area of coastal beach, coastal bank and buffer. Because of the variety and extent of impacts to protected resources, this approach is considered a less desirable alternative than the inlet channel.

Activities during construction of the facility and dredged material disposal could discourage use of the adjacent tidal flats by shorebirds; however, this is a limited resource in terms of area and location, so the interruption would not be expected to be an adverse impact. Use of the site by these birds should resume after capping and closure.

Noise and disturbance during construction and operation of the containment facility could disrupt use of the dilapidated pier by nesting common terns (Massachusetts Species of Concern). The extent of use and success of these small, isolated, urban breeding sites is poorly understood, therefore impacts from adjacent construction activities are difficult to assess. It is likely that the birds would abandon the breeding site during project operation, and could return upon project closure.

GEOLOGY/SOILS

As with Squantum Point, the on-site udorthents represent an unnatural/altered site condition. Therefore, the placement of dredge spoils would not severely alter or change existing geological and/or soil conditions.

HYDROLOGY/WATER QUALITY

Because of the Everett site's proximity to tidal waters, impacts to hydrologic conditions from dredge material disposal, capping and closure would be minimal. Infiltration would be eliminated by the liner system required by MADEP, minimizing impacts to groundwater flow. Surface runoff would be directed to minimize alterations to the existing hydrologic budgets of surrounding lands and tidal flats.

INDIRECT IMPACTS

A playground is located a block away from the site, and a school is less than a half-mile away. Odor from the site and from trucks travelling to the site would be the greatest impact to these sensitive receptors. Daily cover or treatment of the dredged material may be required. Truck traffic already is heavy along Route 99, so the increase in safety hazard and noise caused by transportation of the dredged material may need to be evaluated, although increases over existing levels may not be noticeable. It is unknown to what extent any increase in truck traffic would result in additional traffic delays. If barges are used to transport material to the site, traffic impacts would be eliminated. Noise from industries and traffic already occurs in the area. Therefore, it is not expected that the increase in project noise would be a problem.

AQUATIC RESOURCES

No freshwater runoff impacts at site closure would be anticipated because runoff could be discharged directly into subtidal waters, therefore eliminating impacts to intertidal communities.

WETLAND RESOURCES

Under the preferred barge access route, no wetland resources other than Land Under Ocean would be impacted (see previous section). The containment facility footprint would not impact any protected resources.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

Because there are no identified historical or archeological resources at the Everett site, no impacts would be anticipated. The jackknife bridge upriver of the project would not be impacted.

2.2 SITE EVALUATIONS: LAND-BASED INLAND SITES

2.2.1 Woburn (WOB-11)

The Woburn site is a 59-acre parcel in the Town of Woburn adjacent to the Wilmington town line (Figure A1-4). The site is primarily owned by the town, but is bisected by a parcel owned by Boston Edison Co. High power transmission lines travel the Boston Edison parcel and are joined approximately half way up the site by a transmission line from the northeast along an easement corridor. These power lines effectively trisect the site into 3 parcels: a southern parcel approximately 18 acres in size, an eastern parcel of 13 acres,and a northern parcel estimated to be 24 acres. This assessment will concentrate on the northern parcel for use by the

BHNIP. It is dominated by a temporarily capped municipal landfill, with steep slopes approximately 10-25 feet in height.

2.2.1.1 Existing Conditions

GEOLOGY/SOILS

The topography of the Woburn site is irregular with rounded uplands separated by relatively flat lowlands. The topography of the site reflects the surficial and bedrock geology of the area. The surficial deposits at the site consist of stratified drift and glacial till. The low lying areas of the site are underlain by stratified drift which includes kame and kame terrace deposits of sand and gravel (Castle 1959). Portions of the lowlands have been mined to extract the sand and gravel for use as aggregate material. The upland portions of the site are underlain by dense, poorly sorted glacial deposits of silt, sand and gravel.

Outcrops of bedrock have also been observed (Castle 1959). The bedrock underlying the site has been mapped as Precambrian age metamorphosed mafic to felsic intrusive and volcaniclastic rocks (Zen 1983). These rocks are part of a large fault-bound block which trends northeast to southwest.

The majority of the soils on site are classified as landfill or udorthents (SCS 1989b). Two udorthents are distinguished: on the southern parcel is a sandy udorthent with 3-8% slopes; and on the eastern parcel is a udorthent with a wet substratum. The depth of fill over wetland material is unknown, and within the udorthent series can range from 2-20 feet. (SCS 1989b). Small areas of native soil occur on the northern boundary (Charlton-Hollis-Rock complex, 3-8% slopes) and adjacent to the stream in the southern parcel (Windsor loamy sands, 3-8% slopes).

HYDROLOGY/WATER QUALITY

The site is located in the Mystic River Basin immediately south of its drainage divide with the Ipswich River Basin. Runoff at the site appears to flow to a small stream in the middle of the property, which flows west to east across the site and then south into Hall's Brook (also known as Willow Brook). Locally, groundwater is recharged by the infiltration of precipitation into the surficial deposits. Groundwater appears to flow through the stratified drift deposits to the southeast and then discharge to the valley fill deposits of the Aberjona River.

Most of the site consists of low and very low yield aquifer with 20% of the site consisting of medium yield aquifer (100-300 gpm) (MADEP Groundwater Overlay Maps). There are no groundwater quality data available for the site. It is not known if water quality has been degraded by the existing landfill on the site. The Woburn residential areas near the site rely on Quabbin water through the MWRA, so no private drinking water wells are known to occur downgradient of the site.

At its northern boundary, the site is approximately 1200 feet away from the nearest boundary of the Wilmington Groundwater Protection District A. This district is designated to protect the "zones of contribution of the existing municipal supply wells" (Town of Wilmington 1990). The nearest Wilmington water supply well, the Town Park well, is over 0.8 miles to the north and upgradient of the Woburn site. Three other Wilmington municipal wells are within approximately 1.0 mile of the site.

The site is located in the upper portion of the Mystic River drainage basin. The only surface water on the site is a tributary of Halls Brook which is classified as a Class B waterway. Waters under Class B are freshwaters designated for the uses of protection and propagation of aquatic life and wildlife and for primary and secondary contact recreation. There are no surface water supplies downstream of the site. No water quality data exist for this brook, but as with groundwater, the on-site landfill may have the potential to influence water quality.

AQUATIC RESOURCES

No aquatic resources occur within the proposed footprint of the Woburn site. A stream tributary to Hall's Brook flows through the southwestern portion of the site. At the time of the site visit, the stream flowed very slowly in an easterly direction and was approximately 6-10 feet wide and 1 foot deep. A red brown floc coated many of the stream's bottom features, including the vegetation. No culvert was visible where the access road crossed the stream, although a slight current was apparent. It is assumed that the hydraulic crossing is that of a "farm drain" which allows flow through rock placed at the base of the road and permits flow through their interstices.

VEGETATION

The major portion of the site is a disturbed early-successional field and shrubland. Several small stands of hardwoods remain on the northern portion of the site, and along the small stream. Scattered shrubs, representative of disturbed-site species and most of Eurasian origin, have become established throughout the site.

On the northern parcel, dominant species on the closed landfill include mugwort (*Artemisia vulgaris*), alfalfa (*Medicago lupulina*), grasses (Two *Poa* spp. and *Bromus tectorum*), clovers (*Trifolium repens* and *T. pratense*), and goldenrods (*Solidago* spp.). Scattered small individuals of black locust (*Robinia pseudoacacia*), honeysuckle (*Lonicera tatarica*), and tree of heaven (*Ailanthus altissima*) have become established across the cap. On the steep slopes of the landfill, stands of trees approximately 30-40 feet in height occurred on the east and north sides. Common species included trembling aspen (*P. tremuloides*), gray birch (*B. populifolia*), and staghorn sumac (*R. typhina*).

The disturbed old field portions of the southwestern and eastern parcels support species similar to the plant community on the landfill cap in the northern parcel.

WETLAND RESOURCES

Several areas of freshwater wetlands which will fall within the purview of Section 404 of the Federal Clean Water Act were observed on the Woburn site. Wetland resources as protected by the Massachusetts Wetlands Protection Act and Regulations (MGL c.131, s.40, and 310 CMR 10.00) include Bordering Vegetated Wetlands, Isolated Land Subject to Flooding, Land Under Water Bodies and Waterways, and Banks. The following describes the various wetland resources from general observation. No jurisdictional wetland boundary delineations were performed since site access was limited.

Adjacent vegetation was primarily woody. On the eastern side of the access road, shrubs overhung most of the stream's length; species included common and European buckthorn (*Rhamnus cathartica* and *R. frangula*), red maple (*Acer rubrum*), willow (*Salix* sp.) and honeysuckle (*L. tatarica*). On the western side of the access road, small trees (20-30 feet in height) of red maple, mulberry (*Morus alba*), black willow (*Salix nigra*), and gray birch dominated the stream corridor.

Small isolated wetlands occur in depressions elsewhere on the site. Under the powerline, several herbaceous wetlands less than 0.1 acre in size were observed; along with considerable trash, common plant species included cattail (*T. angustifolia*), bluejoint grass (*Calamagrostis canadensis*), soft rush (*J. effusus*), and jewelweed (*Impatiens capensis*). Northwest of the on-site landfill, a small apparently isolated forested wetland occurred at the base of the landfill slope. Standing water in the middle open portion of the wetland was estimated to be 2.0± feet deep at the time of the site visit, and stagnant in appearance (heavy pollen accumulation, dark brown in color). Last year's herbaceous stems were visible well into the flooded zone, which suggests that water levels will drop significantly as the growing season progresses.

The canopy was quite open, and dominated by red maple, black willow and big-tooth aspen (*Populus grandidentata*), with willow and European buckthorn in the shrub layer. The herb layer contained limited species; a composite thicket condition formed a dense homogenous herbaceous cover in the flooded portion of the wetland. Along the edges, jewelweed and water horehound (*Lycopus* sp.) occurred, along with common reed (*P. australis*) and Japanese knotweed

(*Polygonum cuspidatum*) which crept down the slope of the landfill and encroached on the wetland.

A review of aerial photography revealed a small pond further to the north, occurring very close to the Woburn town line, and a more extensive forested wetland system in Wilmington in close proximity to the northern edge of the site. Neither area was visited during field work, but would not be impacted by the project design.

WILDLIFE

Mammal species typical of sites such as the closed landfill, with sparse herbaceous vegetation, include woodchucks and eastern cottontails. The scattered shrubs and adjacent forest also provided perches or nest sites for species such as indigo buntings, song sparrows and common grackles, all of which use open land or forest edge. Eastern kingbird, tree swallow, and hoary bat are examples of wildlife species that forage over open land and also use adjacent trees for perching, nesting or roosting (DeGraaf and Rudis 1986). The many rocks and other debris on the landfill top also provided good cover for species such as brown snakes and common garter snakes (Hunter et al. 1992).

The hardwood forest on the side slopes of the landfill area was young, with an open canopy (about 40-50% cover), and well-developed shrub and herbaceous layers. Species observed in the forest/shrub habitat included gray catbird, common yellowthroat, song sparrow, and yellow warbler. All of these species typically are associated with brushy habitats.

Several forested wetlands occurred in the area north of the landfill. Wildlife species most likely to occur in these wetlands would include those also able to use the adjacent landfill (e.g., common yellowthroat, song sparrow), adjacent developed sites (e.g., skunk), or the adjacent fragmented forest (e.g., coyote, raccoon). Some species typical of forested wetlands would be unlikely to use the smaller site (e.g., northern waterthrush and veery: DeGraaf and Rudis 1986, Robbins et al. 1989).

Wildlife species observed on the site on either May 12 or 27, 1993, include the following:

Common garter snake (*Thamnophis sirtalis*)
Red-tailed hawk (*Buteo jamaicensis*)
American kestrel (*Falco sparverius*)
Ring-necked pheasant (*Phasianus colchicus*)
Killdeer (*Charadrius vociferus*)
Northern flicker (*Colaptes auratus*)
Blue jay (*Cyanocitta cristata*)
American crow (*Corvus brachyrhynchos*)
American robin (*Turdus migratorius*)
Gray catbird (*Dumetella carolinensis*)
Northern mockingbird (*Mimus polyglottos*)
European starling (*Sturnus vulgaris*)
Yellow warbler (*Dendroica petechia*)
Common yellowthroat (*Geothlypis trichas*)
Rose-breasted grosbeak (*Pheucticus ludovicianus*)
Indigo bunting (*Passerina cyanea*)
Field sparrow (*Spizella pusilla*)
Song sparrow (*Melospiza melodia*)
Red-winged blackbird (*Agelaius phoeniceus*)
Common grackle (*Quiscalus quiscula*)
House finch (*Carpodacus mexicanus*)
American goldfinch (*Carduelis tristis*)
Rabbit (Leporidae family)
Woodchuck (*Marmota monax*)

THREATENED AND ENDANGERED SPECIES

The Mystic Valley Amphipod (*Crangonyx aberrans*) is a crustacean that occurs in cool, shallow, slow-moving or stagnant fresh water with leaf litter; and is only known to occur in New England (MANHESP 1991). It is a Species of Special Concern in Massachusetts. *C. aberrans* has been recorded south of the site in Hall's Brook (Lincoln 1993; MANHESP, letter dated March 1, 1993). The on-site tributary has several of the habitat characteristics required by the Mystic Valley Amphipod: shallow depth, sluggish velocity and leaf litter.

No search for *C. aberrans* was undertaken on the study area, but a 1991 survey sampled the tributary to Hall's Brook downstream of the study area (NAI 1991b). One immature *Crangonyx*, which could not be identified to species, and 17 *Crangonyx pseudogracilis* were collected at this sample point, but no adult *C. aberrans* were recorded at any sample point during the 1991 study. Since *C. pseudogracilis* typically occupy the same habitat as *C. aberrans* (Smith 1983 cited by NAI 1991), this survey reported no *C. aberrans* even in suitable habitat.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources identified on or within 1000 feet of the Woburn site.

SOCIO-ECONOMIC/LAND USE

Woburn (11) is an 59± acre site containing a city landfill and vacant land. Boston Edison power transmission lines cross the site, dividing it into three pieces. People use the site for dirt-biking. The Boston and Maine Railroad tracks run in a north/south direction east of the site. Adjacent to this site is an office park to the east; another office park to the south, along with an industrial park and some residential use; general industrial and residential to the west; and general industrial to the north with some limited residential use.

Woburn, originally known as Charlestown Village, was settled in 1636 by people seeking relief from crowded conditions in Charlestown. Once a farming community, Woburn housed leather tanning and shoe manufacturing operations in the 19th century after the Middlesex Canal was built. These industries have been superseded by metal fabrication and the manufacture of electrical equipment. The predominant land use remains low-density housing. The population of Woburn declined 2% to 35,943 from 1980 to 1990 . The median family income in Woburn is $50,428.

2.2.1.2 Environmental Consequences

The Woburn site can potentially accommodate 158,600 cy of silt. A major engineering drawback of this site is the dome shape of the former landfill that currently dominates the site. The dome would require extensive regrading to construct the basin configuration of the dredge containment facility. The stability and condition of the landfilled material is currently unknown, and would require analysis to ascertain its status for construction. However, a long-term benefit gained by the use of this site would be the secure capping and closure of the landfill, which currently is loosely capped with a coarse mineral cover. Capping would eliminate the present infiltration and leaching from the portion of waste that is above the watertable. Any waste in contact with the groundwater would continue to leach.

DIRECT IMPACTS

Permanent Losses

The placement of dredge spoils and the proposed containment facility would eliminate all existing vegetation within the construction footprint. Upon completion of all on-site activities, early-stage succession of tolerant and opportunistic species should occur. A vegetation plan may be required for the landfill cap, since shallow-rooted species are generally preferable in maintaining cap integrity.

The preliminary design incorporates avoidance and minimization of all wetland resource impacts in its design criteria. As a result, most of the wetlands on the Woburn site and their buffer zones would not be impacted. The exception is a small 1.0± acre forested wetland on the northwest side of the site, in which fill would be placed to ensure adequate sideslope stability during closure of the existing landfill. More detailed site information would be necessary to further quantify surface area impacts to the wetland from any fill. The functions and values of this wetland have not yet been evaluated but due to its small size, isolation, and disturbed conditions, the wetland is expected to be of relatively low value for biological support, flood control, wetland wildlife habitat and water quality functions. Aesthetic, recreational, and educational values are also expected to be low because of its disturbed setting and lack of public access. Therefore, impacts to this area of wetland would likely be minor.

Construction of the containment facility would result in the loss of all upland wildlife habitat within the disposal footprint until capping and closure of the site were completed. Upon closure of the project, there would be an opportunity for natural recruitment and restoration and improved habitat quality by eliminating exposed trash and future dumping. As described above, a limited permanent wetland wildlife habitat loss would also occur, but is expected to be of minimal significance.

Temporary Losses

Travel to the site would be along secondary and local roads and would pass by residences. Truck traffic to the site could increase noise and odor levels and could create safety problems, particularly along Merrimac Street and New Boston Road. A new exit from Route I-93 and development of a proposed rail siding east of the site will not be completed in time for BHNIP's schedule.

GEOLOGY/SOILS

On-site udorthents represent an unnatural and altered soil condition. Given the sandy gravelly deposits, placement of silty dredge spoils could change the surficial character of on-site soils not associated with the landfill. The dredge spoils could provide quality material for capping of the landfill area.

HYDROLOGY/WATER QUALITY

Because the quality of groundwater resources at the Woburn site is unknown, potential impacts cannot be fully addressed. However, a liner would be required by MADEP and would minimize leakage of contaminants from the dredged material into the groundwater. A potential benefit of using this site is that an unsecured landfill would be capped by the dredging project. This action could result in improvement of the groundwater quality by eliminating the present infiltration and leaching of that portion of the waste deposited above the water table. Any waste in contact with groundwater would continue to leach.

To avoid impacts from high chloride levels, the dredged material would be dewatered at Boston Harbor prior to transport to the Woburn site. Dewatering facilities are described in the dredge management plan (Section 3.0 of the EIR/S); monitoring requirements of MADEP would be in place to keep impacts from the dewatering process to an acceptable level in the surface waters of Boston Harbor.

No impacts to surface waters surrounding the disposal site are anticipated during the dredge disposal phase. The leachate collection system and the liner would be used to collect any excess water or contaminants. Leachate treatment would be controlled to prevent impacts to the surrounding environment. At the end of the dredge disposal phase (2± years), the site would be capped with an impermeable cover to prevent further infiltration or surface water runoff from the dredged material.

After the site has been capped and revegetated, runoff quality should resemble that of adjacent undeveloped land. Runoff quality should also improve because the currently sparse vegetation, steep slopes, exposed soils and trash are all likely to degrade existing runoff quality.

AQUATIC RESOURCES

Runoff into wetlands adjacent to the site would be controlled to keep sediments from entering the wetland during the dredge disposal phase. After site closure, runoff would be redirected to best approximate the pre-project water budget of these wetlands.

THREATENED AND ENDANGERED SPECIES

No known threatened and endangered species use the Woburn site; therefore, no impacts would be anticipated.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources on or near the Woburn site; therefore, no impacts would be anticipated.

SOCIO-ECONOMIC/LAND USE

The site is an abandoned landfill, intersected by powerlines and a sewage pipe. The site is primarily owned by the City of Woburn, with a parcel owned by the Boston Edison Co. Use of this site for the project would not result in any loss of tax revenue to the City of Woburn, since no work would be done near the powerline. The powerlines and pipeline on the site would not be impacted by the project. Also, capping the site after project completion would save the City of Woburn the expense of capping the existing landfill.

The site is primarily industrial, with some nearby residences. Noise and odors from the site could affect some of these residences. Odors would possibly need to be controlled daily by covering the dredged material. Daily cover requirements would reduce the available site capacity. Noise and odor also would be lessened by prevailing winds. The direction of prevailing winds is from the west, and no residences occur immediately east of the site.

2.2.2 Wrentham (WREN-495)

The Wrentham site is approximately 181 acres in size, and is located at the intersection of US Route 495 and Route 1A (Figure A1-5). The site is undeveloped and is bordered primarily by I-495, open land and an active sand and gravel pit (Bardon Trimount Quarry and Asphalt Plant). Several single family residences lie within 500 feet on the east and west of the site; an abandoned railroad bed forms the eastern boundary. Privately owned by Simeone Corporation, the site is bisected by a power transmission line for which New England Power Company has an approximately 325 ft wide easement. The northern portion of the site currently has a proposal for a 23-acre sand and gravel operation in anticipation of an industrial subdivision (Landmark Engineering of New England, Inc., 1993). Because this site is private property, on-site access was not gained; observation are from the site borders, aerial photographs (black and white, 1:6000, dated December 11, 1991), and resource maps (1987 U.S.G.S. Franklin, MA topographic quadrangle and the 1989 SCS soil survey).

2.2.2.1 Existing Conditions

GEOLOGY/SOILS

The topography of the Wrentham site ranges from an upland area in the northeast portion of the property to several water filled depressions in the central and southern portions of the property. The upland areas are underlain by dense, poorly sorted glacial till and bedrock. The lowland areas in the central and southern portions of the property are underlain by stratified drift.

Portions of the stratified drift deposits in the southern portion of the property have been mined for sand and gravel.

Outcrops of bedrock are found in the upland portions of the property. Based upon the Bedrock Geological Map of Massachusetts (Zen 1983), the bedrock underlying the site consists of the Precambrian Age Dedham Granite. Dedham Granite is part of a structural block which trends northeast to southwest. In the vicinity of the property the Dedham Granite is traversed by a north to south trending normal fault.

Soils on the site are predominantly well drained and somewhat excessively drained outwash and till soils (SCS 1989a). Except for the level idorthents in the quarry areas, slopes range from 3-8% to 15-35%. The Charlton-Hollis-Rock Outcrop complex includes a dominant sandy till, but also included are till areas of Canton fine sandy loam, and outwash deposits of Hinckley fine sandy loam and Merrimac fine sandy loam. A linear unit of ponded Freetown muck, a very deep organic deposit, is associated with a small stream on the western edge.

HYDROLOGY/WATER QUALITY

The site is underlain by medium yield aquifer; approximately one-third of the site is designated as MADEP Zone II Wellhead Protection Area (MADEP Groundwater Overlay Maps). There are no municipal drinking water wells located on the site as the area is primarily serviced by a municipal piped system. No groundwater quality data were available for the site. There is a proposed municipal well approximately 0.15 miles west of the site. This proposed well location is in the Blackstone River basin, out of the watersheds of the project study site; however, actual groundwater divides may not coincide with surface watershed boundaries.

The north and west portions of the site are located in the Charles River basin while the south portion is in the Ten Mile River basin. There are several small ponds and a stream located on the site, but no water quality data were available. Surface waters on the site in both watersheds are classified as Class B waterbodies. Waters under Class B are fresh and designated for the uses of primary and secondary contact recreation and for the protection and propagation

of aquatic life and wildlife. Several private wells are near the site for residences on portions of Green Street and Route 1A.

AQUATIC RESOURCES

Several small kettlehole ponds occur within the central project area. Most appeared to be steep sided; however, the largest pond (on the eastern side of the site) was shallow, with aquatic vegetation visible throughout. On the western edge of the site lies an unnamed stream which drains to Eagle Brook after flowing north through a series of off-site ponds. In June, the stream was approximately 4.0 feet wide and 6 to 8 inches deep, with a sand and detritus bottom and sluggish flow.

VEGETATION

Vegetation cover types and wetland identification were ascertained from stereo aerial photographs (black and white, 1:6000, dated December 1991), and ground truthed only peripherally from the old railroad grade, Green Street, and an improved gravel road bisecting the site. Should this site be selected, a more thorough site investigation would be required to determine jurisdictional wetland boundaries and more detailed vegetation descriptions.

The scrubland northwest of the active quarry area was on a low rolling dry plain bordered by several prominent rock outcrops. Based on vegetation composition and structure, the soil appeared to be well-drained poor sands with an average litter layer. The vegetation was dominated by a mixture of oaks, approximately 15 feet tall and many with multiple stems. Oak species included red oaks (probably *Quercus coccinea* and *Q. rubra*), scrub oak (*Q. illicifolia*) and white oak (*Q. alba*). Minor representatives of other tree species such as red maple (*Acer rubrum*), cherries (*Prunus* spp.) and gray birch (*B. populifolia*) were also observed. Tall snags of white pine (*Pinus strobus*) were scattered across the site. The understory was dominated by a lowbush blueberry (*Vaccinium* sp.), with sweet fern (*Comptonia peregrina*), meadowsweet (*Spirea latifolia*) and blackberry (*Rubus* sp.) also common. The herbaceous layer was sparse and indicative of dry site conditions: bracken (*Pteridium aquilinum*), Pennsylvania sedge (*Carex pensylvanica*) and

haircap moss (*Polytrichum* sp.) were dominant species. Even a small swale running the length of the site appeared to be dominated by upland species, again supporting the SCS classification of well-drained soils on the site.

Shrublands elsewhere on the site were similar in structure and general species composition. Other common species included multiflora rose (*Rosa multiflora*), willows (*Salix* spp.), poison ivy (*T. radicans*), and tree-of-heaven (*A. altissima*). The forested portions of the site were hardwood-dominated with red oaks and white ash (*Fraxinus americana*) as the principal species. Other observed species include sassafras (*Sassafras albidum*), sugar maple (*Acer saccharum*), big-tooth aspen (*P. grandidentata*) and white pine. Understory species included white oak, gray birch, black cherry (*P. serotina*), poison ivy, and lowbush blueberry as well as canopy species. Structure was typical of second-growth forests of the area; canopy height was approximately 70 feet, with a maximum stem diameter at breast-height of about 18 inches, and an estimated 70% canopy closure.

Several small open areas of old field occurred. Soils were obviously poor and well drained, with many surface rocks and cobble. The vegetation was typically early-successional, dominated by forbs such as asters, goldenrods, yarrow (*Achillea* sp.), ragweed (*Ambrosia artemisiifolia*), wild carrot (*Daucus* sp.), grasses (*Poa compressa* and others), and sedges (*Carex brevior*). Scattered shrubs (willows, meadowsweet and sweet fern) were established.

WETLAND RESOURCES

Several areas of freshwater wetland occur across the Wrentham site will be subject to review under Section 404 of the Federal Clean Water Act. Jurisdictional resources under Massachusetts Wetlands Protection Act and Regulations (MGL c.131, s.40, and 310 CMR 10.00) on the Wrentham site include Bordering Vegetated Wetlands, Land Under Water Bodies and Waterways, Isolated Land Subject to Flooding, and possibly Banks.

In the northern and western portions, forested wetlands occurred either in isolated depressions on the landscape or associated with small ponds. On the far western edge lies an

unnamed stream system which drains into Eagle Brook. The stream is bordered by a wide swath of wooded wetlands, except where it traverses a residential landscaped lot. The wooded wetland is primarily red maple (*A. rubrum*) with a minor element of white ash and other species. The understory was relatively dense with woody species such as red maple, swamp azalea (*R. viscosum*) and spice bush (*L. benzoin*). Herbaceous species included sensitive fern (*Onoclea sensibilis*), royal fern (*Osmunda regalis*), skunk cabbage (*Symplocarpus foetidus*) and sedges (*Carex* sp.). Immediately bordering the stream, the overstory opened up to a dense shrub swamp.

On the southern and eastern portions of the site, where the vegetation is predominantly low secondary growth, scattered shrub wetlands in isolated basins and in small drainages occur. Under the powerlines, vegetation is maintained by mowing or herbicides, and emergent/shrub wetlands were evident on the aerial photographs. Several small kettlehole ponds dot the central portion of the site. These ponds generally appear to be steep sided with few bordering wetlands. The largest pond was observed from the railroad tracks to have a narrow band of shrub swamp bordering its shores. The pond was shallow throughout, with pond lilies and emergent species dominating most open water areas. A narrow shrub swamp separated this pond from an adjacent smaller pond, but a surface hydrologic connection almost surely occurs at high water levels.

WILDLIFE

The scrublands could be expected to support many of the species typical of dry, brushy habitat (e.g., American redstart, gray catbird, New England cottontail: DeGraaf and Rudis 1986; redbelly snake: Hunter et al. 1992). The rufous-sided towhee, is typical of brushy habitat, forages in leaf litter (DeGraaf and Rudis 1986), which was abundant at this site.

The hardwood forest had a good vertical structure, with well-developed shrub and herbaceous layers. Wood thrush and woodland jumping mouse are typical of this forest type (DeGraaf and Rudis 1986). A well-developed layer of duff, a stonewall, and abundant logs would favor small animals requiring cover: for example, chipmunks, masked shrews, and redback salamanders (DeGraaf and Rudis 1986).

A small early successional field in the southern corner of the site contained sparse herbaceous vegetation, with some scattered shrubs and an occasional tree. Common yellowthroat, song sparrow and mourning dove would be expected in this habitat type. This habitat may be suitable for the northern hairstreak, a butterfly which is described in the "Threatened and Endangered Species" section.

The ponds appear to have poor interspersion of vegetation types and vegetation and water. Therefore, it is likely not to be important for waterfowl brood rearing. Canada goose scat was observed on the pond edge. These geese probably were feeding there.

The stream, moist soil and dense shrub layer in the red maple swamp would attract species such as veery, short-tailed shrew and yellow warbler (DeGraaf and Rudis 1986) as well as two-lined salamanders (Hunter et al. 1992), all of which would not occur in the other, drier cover types.

Some wildlife species may use a combination of habitats. For example, American kestrels may perch in the snags jutting above the scrubland and forage above the scrubland and in the adjacent early successional field (DeGraaf and Rudis 1986). White-tailed deer from the forest may browse on saplings and shrubs in the scrubland. Eastern kingbirds or eastern phoebes may hawk insects above the shrubs from perches at the forest edge or in the supercanopy snags.

The Wrentham site and its vicinity are intersected by a powerline, an interstate highway, several secondary roads, a dirt road, and a gravel mining operation. It is too fragmented to be used by species that breed in large tracts of unbroken forest (e.g., black-throated blue warbler: Robbins et al. 1989). However, wildlife species that use a variety of habitats and that have home ranges of a half-mile or more in diameter may use the site as part of their domain. Examples include red fox, striped skunk and raccoon (DeGraaf and Rudis 1986).

The following species of wildlife were observed on the project site on May 12 and June 21, 1993:

Bullfrog (*Rana catesbeiana*)
Canada goose (*Branta canadensis*)
Red-tailed hawk (*Buteo jamaicensis*)
Killdeer (*Charadrius vociferus*)
Rock dove (*Columba livia*)
Mourning dove (*Zenaida macroura*)
Eastern phoebe (*Sayornis phoebe*)
Eastern kingbird (*Tyrannus tyrannus*)
Blue jay (*Cyanocitta cristata*)
Tufted titmouse (*Parus bicolor*)
American robin (*Turdus migratorius*)
Gray catbird (*Dumetella carolinensis*)
Northern mockingbird (*Mimus polyglottos*)
European starling (*Sturnus vulgaris*)
Blue-winged warbler (*Vermivora pinus*)
Prairie warbler (*Dendroica discolor*)
Indigo bunting (*Passerina cyanea*)
Rufous-sided towhee (*Pipilo erythrophthalmus*)
Song sparrow (*Melospiza melodia*)
Common grackle (*Quiscalus quiscula*)
House finch (*Carpodacus mexicanus*)

THREATENED AND ENDANGERED SPECIES

Two species identified by the State of Massachusetts as of Special Concern occur adjacent to the site (MANHESP, letter dated March 1, 1993): and include the northern hairstreak butterfly (*Fixsenia ontario*), and Philadelphia panic grass (*Panicum philadelphicum*). Both species are typical of open ground.

The northern hairstreak occurs at disturbed sites that are dry, open and sparsely vegetated, such as power lines, railroad rights-of-way, and abandoned gravel pits (Hildreth,

undated). The old fields and parts of the powerline right-of-way and abandoned railroad bed may provide appropriate habitat for this species. These areas would need more intensive investigation to determine whether they provide suitable conditions.

The Philadelphia panic-grass occurs in open areas or thin woods (Fernald 1950). In Massachusetts, it has been found in open wetlands, along the shores of water bodies, and in depressions (MANHESP 1992). The most likely place for it to occur on the study area would be in the wetlands within the powerline corridor and along the banks of open water throughout the study area.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources on or within 1000 feet of the Wrentham site.

SOCIO-ECONOMIC/LAND USE

This 181-acre site is predominantly open land, with an active quarry and asphalt plant at its southern tip. It is located immediately southwest of the Route 1A Interchange on Route I-495 and near the Wrentham State Forest. The vast majority of the site is undeveloped shrub and forestland containing some ponds and wetlands. There are some residences abutting the property.

Wrentham was first settled in 1669 and was considered part of Dedham. Industries that developed in the town during the 19th century included the production of straw hats and jewelry. The major employer in the town today is the State, reflecting the presence of a state school for the retarded. The population of Wrentham is 98% white. The median family income is $51,184.

Access to the site is via I-93 south to Route I-95 south, and northwest on Route I-495 to Route 1A to High Street to Green Street and onto the site.

2.2.2.2 Environmental Consequences

The Wrentham site is the largest of the land-based potential disposal sites, with an estimated capacity of 785,000 cy. This size may be sufficient to accommodate all of the silts since the dewatering process is likely to reduce the volume of the silts to below the in-situ volume, however the extent of wetlands and MDEP Zone II Wellhead Protection Area greatly reduce the suitability of this site. Due to the permitting and design concerns these two resource areas raise, this site may be more suitable for consideration as a disposal area for future maintenance material.

DIRECT IMPACTS

Permanent Losses

The preliminary design of three containment structures within the site incorporates avoidance and minimization of impacts to wetland resources in its design criteria. As a result, most of the larger wetlands and wetland complexes would be avoided altogether (based on the restricted in-field wetland assessment and findings to date and wetlands as mapped on Massachusetts Bureau of Waste Site Cleanup Resource Maps). Several areas of wooded and shrub wetlands in the interior portions of the two parcels would be filled. Under the preliminary design presented in the DEIR/S, over 15.0 acres of identified wetland resources protected under the Federal Clean Water Act would be impacted. Under Massachusetts regulations, this acreage includes both Bordering Vegetated Wetlands and Isolated Land Subject to Flooding. Additional field surveys would be necessary to determine more accurately the extent and proportion of wetland in each resource category and to assess their functions and values. Reconfiguring the containment facility to avoid these wetlands would reduce the capacity of the site by approximately 45% to 430,000 cy.

Construction of the containment facilities would result in the loss of all wildlife habitat within the project footprint until capping and closure of the site was completed, and revegetation commenced. If managed as open space with natural vegetation, the site would likely regain much of its current value as wildlife habitat.

The on-site potential for use by the Philadelphia panic grass and Northern hairstreak should be verified, because both species have been recorded at nearby locations. The scrub-shrub wetlands and old-field areas are the most likely habitats in which to find these two species, respectively. These habitats occur throughout the southern portion of the site. Upon detailed field investigation by experts of these two species, impacts to areas identified as potential habitat would be avoided.

The placement of dredge spoils and construction of the proposed containment facility would eliminate all existing vegetation within the footprint. Being a disturbed site, the existing vegetative composition and structure is of a shrubland, scrubland, and forb dominated old field. Following capping and closure of the site, this type of vegetative character would likely return.

Temporary Losses

Green Road already is used heavily by quarry trucks. The project would increase truck traffic. Odors from dredged material along the truck route could be a concern.

INDIRECT IMPACTS

Much of the northern portion of the site is within a MDEP Zone II Wellhead Protection Area (Bureau of Waste Site Cleanup Resource Maps), which violates DEP's landfill siting suitability criteria (310 CMR 16.40:3(a)1). Although the proposed containment facility would be lined and have a leachate collection system, the potential risk of contamination of the aquifer through liner leakage or failure cannot be eliminated. Reconfiguring the containment facility to avoid the Zone II aquifer would reduce Wrentham's capacity to 710,000 cy.

Avoidance of both wetland and Zone II aquifer resources results in the elimination of the northern cell entirely, and an overall reduction in the capacity of the site by approximately 60% to 315,000 cy.

Construction of the facility would result in the fragmentation of a relatively large tract of undeveloped land which could discourage use by those wildlife species which require large areas. This impact would be expected to be moderate because the forest and shrub communities are common in the region, and the study area presently contains an active gravel and asphalt operation. Upon closure and revegetation of the site, the fragmentation effects would be minimized as the vegetation succeeds and matures.

GEOLOGY/SOILS

The site would require regrading prior to construction of the lined containment facility and deposition of the dredged silts. These activities could require extensive earthmoving of sandy/gravelly till and filling with silt, thus potentially changing general surface soil characteristics. Blasting or drilling could be required to remove all or a portion of the existing bedrock outcrops.

The site is presently worked, and represents an altered condition; therefore, the placement of the containment facility and dredge spoils would not adversely impact existing geologic and/or soil conditions.

HYDROLOGY/WATER QUALITY

As with the Woburn site, impacts to surface water would be minimized during the dredge disposal phase by a combination of dewatering the dredged material prior to transport to the site, and by maintenance of a liner and leachate collection system.

These actions would prevent chloride, sediment and any sediment-related contaminants from entering surface waters. Dewatering facilities are described in Section 4.0 of the FEIR/S; MADEP discharge and monitoring requirements would keep dewatering impacts to surface water quality within an acceptable range in Boston Harbor.

Runoff from capped portions of the disposal site would be controlled so as to minimize erosion risks prior to entering any surface water system.

AQUATIC RESOURCES

As described in the Water Quality section, the on-site stream and small ponds would be protected from contamination during the dredged material disposal phase by dewatering prior to on-site disposal, and by the liner-leachate collection system. Surface runoff from the project would be treated using appropriate erosion control methods and controlled to avoid directly entering aquatic habitats. After site closure, runoff from the project area would be redirected to best approximate the pre-project water budgets of surrounding aquatic habitats.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

Since there are no listed historical or archeological resources on or near the Wrentham site, no impacts are anticipated.

SOCIO-ECONOMIC ISSUES

Odor and noise from the site should not be a concern near the quarry and asphalt plant because they would not likely be distinguishable from existing noise and odor levels there. However, in the northern part of the project, which is farther away from the plant and closer to the residences, odor and noise could become a concern. Daily cover or chemical treatment of dredged material could be required to control odors.

The project site is owned by Simeone Corporation, which has proposed to extract sand and gravel from the portion of the site that abuts Route I-495 in preparation for an industrial subdivision (Landmark Engineering of New England, Inc. 1993). Use of the northern part of the site by the project would deprive the Town of Wrentham of existing tax revenue as well as the potential tax revenue from the subdivision. Use of the southwestern parcel would result in loss of existing tax revenues, as well as any potential for future development.

2.2.3 Landfill Sites - An Overview

Three private solid waste landfills within reasonable haul distance have been identified that could accept portions of the dredged silt material. These three sites include Laidlaw Waste Systems Sanitary Landfill at Plainville, BFI-Northern Disposal, Inc. in East Bridgewater and Fitchburg/Westminister Sanitary Landfill in Fitchburg. All are lined facilities with leachate collection systems. None have special waste permits but all are willing, within their MADEP Solid Waste Site Assignment restrictions, to accept dredged material pending MADEP and local board of health approval. Table A1-1 summarizes the features and constraints of each site for comparative purposes.

Use of a portion of the dredged material as daily and intermediate cover is also a possibility at all three sites. To be considered suitable for intermediate cover the material must meet the physical and chemical standards described under 310 CMR 19.00 and expanded on by MADEP. Use as final cover should also be considered, provided the material meets the 310 CMR 19.00 standards, including criteria for Toxic Characteristic Leaching Procedures (TCLP), pH, solids, and reactivity.

As required by 310 CMR 19.00, the introduction of a special waste to any of the candidate sites should not impact the public health, safety and the environment by comprehensively regulating the storage transfer process, treatment, disposal, use and reuse of solid waste. Protection of these issues generally requires a comprehensive site evaluation and/or assessment which evaluates on-site and offsite conditions and receptors relative to public health and environmental risk. Since these candidate landfill sites are lined and presumed suitable to receive "special wastes," all issues of public health and environmental risk have been addressed previously. Therefore, both existing and proposed condition narratives, as contained herein, are brief. Potential impacts for each candidate landfill site are summarized in Table 2.3.2-7 of the EIR/S.

2.2.3.1 Existing Conditions

PLAINVILLE SANITARY LANDFILL

Laidlaw Waste Systems' Landfill of Plainville is a double-lined RCRA facility, operated by Laidlaw Waste Systems, Inc. in Plainville, MA (Figure A1-6). Access is via Route I-495 to Route 1 N and Madison Street, with an approximate travel time of 1.0 hour from Boston Harbor (35± miles).

Although no dredged material has been landfilled at the Plainville site, they have accepted grit and screenings from MWRA sewage treatment projects. Plainville was considered for the disposal of dredged material from the Moran terminal on Boston Harbor but a different site was selected. The landfill can accept materials containing up to 1000 ppm total petroleum hydrocarbons. Materials must contain at least 40% solids. Laidlaw engineers must review bulk sediment test results, and materials for disposal must contain no free-standing water. Any further need for testing will be determined by the MADEP. Coordination with the Plainville Board of Health consists of submitting an information package about the proposed disposal to the Board for review.

The landfill is very concerned about odor control, because of a campground near the site. Deodorizing agents will be required after disposal should odor problems develop.

Plainville expects to exceed its permitted capacity in 1995, but has several expansion proposals in various stages of preparation. One of the proposals, currently undergoing MADEP review, would extend the site's capacity for approximately one year, if approved. Three other expansions could potentially provide disposal capacity until the year 2000.

FITCHBURG/WESTMINSTER SANITARY LANDFILL

Fitchburg/Westminster is a lined solid waste facility operated by Resource Control, Inc. in Fitchburg, MA (Figure A1-7). Access is gained via Princeton Road off Route 2, with an approximate travel time of 1¼ hours from Boston Harbor (45± miles).

The landfill has not received dredged material for disposal but has accepted petroleum-contaminated soil and wastewater treatment plant sludge. In addition to meeting 310 CMR 19.00 standards, waste disposal material must be at least 25% solids and contain no free-standing water upon arrival at the site. No nuisance materials can be accepted at the landfill, so disposal material must be odor-free. Local coordination with both the Westminister and Fitchburg Boards of Health is required.

Fitchburg/Westminster expects to exceed its permitted capacity in 1997. No expansions are currently proposed.

BFI-NORTHERN DISPOSAL, INC.

Northern Disposal, Inc. is a lined facility operated by Browning Ferris Industries in East Bridgewater (Figure A1-8). Access requires taking Route 24 to Route 27 onto Thatcher Street. Time of travel is estimated to be 45 minutes from Boston Harbor (25± miles).

This landfill has accepted dredged material from another project in the last three years, as well as small volumes of sewage sludge and petroleum contaminated soils. This landfill was selected for the disposal of dredged material from the Moran Terminal on Boston Harbor. The landfill can accept materials with no free-standing water and a minimum of 20% solids. Approval for disposal is required from both DEP and the Town of East Bridgewater Board of Health. Odor is a particularly sensitive problem as several residences are located very close to the landfill. Deodorizing agents will be required after disposal in the event that odor problems develop.

Northern Disposal, Inc. expects to exceed its current permitted storage capacity in 1996, although it may pursue a vertical expansion.

2.2.3.2 Environmental Consequences

The three landfills under consideration for disposal of the silt sediments are all constructed to handle the material so as to avoid impacts on the environment. They are all lined facilities and strictly regulated for waste-stream handling and disposal. Because of their similarities, they will be addressed together in terms of project impacts using landfills as disposal options.

GEOLOGY/SOILS

Geological and soil conditions at landfills are generally accepted to be severely altered from pre-landfill dumping activities. Landfills designated for waste or special waste disposal can readily accept several forms of waste which meet their specific designation. Therefore, specific impacts on geology/soil would not be an issue.

HYDROLOGY/WATER QUALITY

The dredged material would be dewatered at Boston Harbor prior to being trucked to a landfill site. Dewatering is required to eliminate standing water and to achieve the criteria for percentage of solids specified by each landfill. Dewatering at Boston Harbor would reduce the volume of dredged material and therefore the project truck traffic, and would minimize the problem of chloride handling in a freshwater environment. The dewatering facility described under the Dredge Management Plan (Section 4.0 of the EIR/S) would also be utilized for the landfill disposal option. As with the upland inland sites, no adverse water quality impacts to Boston Harbor are anticipated due to the MADEP permit requirements.

AQUATIC RESOURCES

No impacts to aquatic resources would occur at the landfill sites or Boston Harbor as a result of dewatering.

WETLAND RESOURCES

No impacts to wetland resources would occur at the landfill sites or Boston Harbor as a result of dewatering.

WILDLIFE

No impacts to wildlife would occur at the landfill sites or Boston Harbor as a result of dewatering.

THREATENED AND ENDANGERED SPECIES

No threatened or endangered species are known to occur at any of the landfill sites, or at the Boston Harbor dewatering facility, so no impacts would occur.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

No historical or archeological resources are known to occur at any of the landfill sites, or at the Boston Harbor dewatering facility, so no impacts would occur.

SOCIO-ECONOMIC/LAND USE

Each are existing and active landfills so that their individual or collective use should not pose any additional socio-economic/land use impacts on their respective communities.

2.3 SITE EVALUATIONS: NEARSHORE AQUATIC SITES

2.3.1 Existing Conditions

2.3.1.1 Mystic Piers (Massport Piers 49 & 50)

The site is depicted on Figure A1-9.

SEDIMENT CHARACTERISTICS

Like all of Boston Inner Harbor, the Mystic Piers site is a depositional environment (EG&G 1984), accumulating fine grained sediments (silts and clays). Sediment sampling along the harbor-face of Massport's Mystic Piers 1 (Station 1), 49 and 50 (Stations 1 and 2), adjacent to the proposed disposal site, revealed that the silt-clay component was 41-78%, averaging 60% (see EIR/S Section 2.2). Benthic grabs collected within the proposed disposal area contained predominantly silty sediments, although gravel was present in one sample.

No within-berth data were available for assessing sediment quality. However, all stations sampled to characterize berth-area dredged materials were within approximately 400 feet from the mouth of the proposed Mystic Pier disposal site and may be indicative of sediment quality. Assuming these data reflect conditions within the Mystic Pier site, the sediments are likely to contain moderate to high levels of metals and organics. Arsenic, chromium, copper and mercury likely occur in Category II levels; lead and zinc likely occur in Category III levels. Total PAHs concentrations are likely to be high (>10 ppm), with fluoranthene and benzo(g,h,i)perylene

contributing the highest concentrations. Total organic carbon is likely to be 2-3% of dry weight, indicating a relatively high potential for bioaccummulation of contaminants.

WATER QUALITY AND CIRCULATION

The area of Boston Harbor adjacent to the Mystic Pier site has been classified as Class SB waters by the MADEP. This designates these saline waters for the propagation of marine life, primary and secondary contact recreation and shellfish harvesting with depuration. Water quality of Boston Inner Harbor is strongly influenced by the numerous discharges into the harbor, including CSOs, NPDES discharges and non-point source urban runoff. There is no site-specific water quality data for the Mystic Pier Site; however, water quality can be characterized by Boston Inner Harbor data which are described in Section 4.1.1 of the EIR/S. At the Mystic Pier site there is an outfall pipe, which is a minor discharge consisting of either stormwater, sanitary waste water or from a minor industrial discharge such as non-contact cooling of equipment (Menzie-Cura and Assoc. 1991).

The opening of the Mystic Piers site indicates that water exchange between Boston Harbor and the site is not restricted. Thus, water movement at the Mystic Pier site can be characterized by Boston Inner Harbor currents (described in Section 4.1 of the EIR/S) which are tidally diverse.

In general, water quality and circulation are driven by tidal cycles, and influenced by seasonal weather patterns. High summer temperatures have been reported to depress dissolved oxygen concentrations, often resulting in defaunation in the benthos in Boston Harbor (Hubbard and Bellmer 1989). This condition is commonly referred to as the "August Effect," and will be also referred to throughout this document.

AQUATIC RESOURCES

The site was visited during low tide on April 28, 1993, to evaluate habitat conditions. The intertidal zone is restricted to the tidal excursion vertically along the walls and pilings surrounding the Mystic Piers site, except in the southwest corner where rubble has accumulated in sufficient quantity to be exposed at low tide. Intertidal portions of the western and northern walls were covered extensively with algae (primarily *Fucus* sp. with some *Spongomorpha* sp.). The pilings along the southern perimeter were heavily covered with barnacles, blue mussels (*Mytilus edulis*) and green algae (*Spongomorpha* sp.) with algal cover increasing with distance from the mouth. Diatoms were present on the algae and rubble. Mussels and macroalgae both provide habitat for other organisms. These communities may be exploited for food or shelter by crustaceans and finfish.

Benthic Infauna

Two areas were sampled (in April 1993) for benthic infauna. Results (extrapolated to number/m^2) are reported on Table A1-2. Station MP-1, adjacent to the pilings, was nearly azoic (two taxa totalling 86 individuals/m^2) while Station MP-2, near the head of the site, contained 17,759 individuals/m^2 (11 taxa) of which 11,954/m^2 were nematodes. The total abundance at MP-2 was in the range observed by the Corps in the Chelsea Creek and Confluence Area in 1986. However, the channel stations were dominated by polychaetes (>70%) while the Mystic Pier station was dominated by nematodes (67%). *Capitella capitata* and oligochaetes comprised 85% of the remaining organisms. These predominant taxa are classified as pioneer taxa. Nematodes are early settlers in organically enriched sediments whose presence stimulates microbial degradation of organics (Tietjen 1982). Oligochaetes and *C. capitata* are typically associated with organically enriched, stressed environments. Its reproductive strategy enables *C. capitata* to colonize disturbed sediments rapidly. No amphipods or live mollusks were collected. The moderate abundance of infauna (17,759/m^2) in at least a portion of the site contributes to the productivity of Boston Harbor and these near-surface dwelling organisms are available as prey items for crabs and demersally feeding fish. Winter flounder (*Pleuronectes americanus*) have

been documented as feeding on *C. capitata* in Boston Harbor (Haedrich and Haedrich 1974; NAI 1985), although their preferred prey includes amphipods and large worms.

Sediment profile camera sampling in October 1994 at three locations showed two types of benthic habitat (NAI and Diaz 1995). On the northern side of the site, sediments were muddy with pit and mound topography, indicative of a depositional environment. The Redox Potential Discontinuity (RPD) layer, an indication of the degree to which subsurface sediments are oxygenated, was located at 0.5-1.0 cm below the sediment surface, indicating poor oxygenation. There were a few infauna tubes at the sediment surface but no other indications of bioturbation. The information suggests the area is under environmental stress and characterized by a colonizing or pioneering benthic community. Benthic samples confirmed this assessment. Only one taxon, the surface-dwelling gastropod *Nassarius trivittatus*, was collected with a density of 37.5/m^2 (Habitat II, Table A1-3). Abundances were also low in this area in 1993 (MP-1, Table A1-2).

Sediment profile camera sampling on the southern border of the site revealed fine sand sediments overlaying silt, suggesting occasional erosional conditions. The RPD layer was located at 1.3 cm below the sediment surface, indicating greater sediment oxygenation than in the northern Mystic Pier area. Some indicators of bioturbation, including infauna tubes and anoxic voids, were observed. Benthic samples from this area revealed a slightly more diverse community (5 taxa/.08m^2, Habitat IV, Table A1-3). Total abundance was low (62.5/m^2), much lower than that in the same area (MP-2) in 1993 (17,329, Table A1-2). Dominants included the opportunistic polychaete *Streblospio benedicti*, the gastropod *Nassarius trivittatus*, and amphipod *Ampelisca abdita*, which together composed 60% of the total abundance. Numbers of taxa and total abundance were among the lowest of Inner Harbor stations. The benthic community in this area would still be considered pioneer or colonizing, but under slightly less environmental stress than in the northern area at Mystic Piers site.

Finfish

Finfish were not sampled at this site. However, recent finfish surveys in the Mystic River and Inner Confluence give an indication of the species that could move into this area. Haedrich and Haedrich (1974) observed 23 species in the Mystic River including winter flounder, rainbow smelt, and alewife. A fall 1994 trawl survey of demersal fish in the Mystic River and Inner Confluence collected winter flounder, Atlantic tomcod, windowpane, scup and rainbow smelt (Table A1-4). Scientific names for fish species are provided in Table A1-5. Gill netting in the Little Mystic Channel at the same time collected rainbow smelt and Atlantic tomcod (Table A1-6).

Characteristics of the Mystic Piers site may enhance the suitability of the habitat for finfish. The pilings and wharf, shading the area below, offer shelter from predators. The orientation of the site perpendicular to the main channel provides shelter from currents. Both subtidal and intertidal benthic resources in some areas could provide prey items. Soft substrate could support feeding by demersal species (e.g., winter flounder). Fish such as cunner, tomcod, and sculpins could feed on the fouling community on the walls and pilings (Edwards et al. 1982; Menge 1982; Ojeda and Dearborn 1990). Two species of particular concern are alewife and winter flounder. The anadromous alewife spawns above the head of tide of the Mystic River so reproductive adults migrate upriver past the Mystic Piers site between April and May (Whitlatch 1982). Adults descend the river during the summer, juveniles swim downriver past the site from late summer-fall (Loesch 1987). Another anadromous species, rainbow smelt, may also use this portion of the Harbor. Winter flounder is one of the most abundant species in Boston Harbor where it is considered to be a resident. It prefers to spawn on sand common in the outer harbor (Bigelow and Schroeder 1953).

WETLAND RESOURCES

Under the jurisdiction of the Massachusetts Wetlands Protection Act (MGL c.131, s.40 and 310 CMR 10.00) the Mystic Piers site is a Designated Port Area (DPA). DPAs are almost completely developed areas where few or no natural land forms or vegetation remain. They tend to be paved, bulkheaded, and used for heavy industry so that they have virtually no significance

to the interests of the Act, except for Land Under the Ocean. Land Under the Ocean in DPAs are significant to flood control, storm damage prevention, and the protection of marine fisheries, as is Land Under the Ocean outside of DPAs. The major addition is that Land Under the Ocean in Designated Port Areas also provides support for coastal engineering structures, such as bulkheads, seawalls, revetments, and solid fill piers. The site is primarily Land Under the Ocean, potentially important to marine fisheries, storm damage prevention and flood control. Land Under the Ocean within the Mystic Pier provides food resources and shelter; however, the silty substrate is not preferred spawning habitat for winter flounder, nor are the saline conditions conducive to spawning of the anadromous alewife. Storm damage protection and flood control are provided by the vertical granite wall surrounding the perimeter of the site.

Under federal wetlands guidelines, the entire Mystic Piers site is defined as Tidal Waters. The fine-grained character of sediments at the site, as well as proximity to identified contaminants, suggest that the potential for retention of sediments, toxicants and nutrients exists. Abundance and diversity of the benthic fauna varied substantially in the site. Compared to other locations in the harbor, Mystic Piers exhibited moderate potential for supporting higher trophic levels. Construction activities could be more sensitive at this site due to its proximity to an anadromous fish run (in the Mystic River).

WILDLIFE

The aquatic area of Mystic Piers may be used by waterfowl that dive for food (e.g., bufflehead and common goldeneye), birds that hunt fish in the water (e.g., red-breasted merganser and double-crested cormorant), or those that hunt fish from the air (e.g., common tern and belted king fisher). Coastal areas are particularly important to waterfowl during the winter. Inland feeding areas usually freeze, so water-dependent birds such as American black ducks move to unfrozen waters on the coast.

Abandoned piers provide roosting sites for gulls and common terns. Norway rats are also commonly associated with waterfronts (DeGraaf and Rudis 1986). Harbor seals may

occasionally occur since they generally feed in shallow water inshore (FAO Adv. Comm. 1976, cited by Chapman and Feldhamer 1982).

THREATENED AND ENDANGERED SPECIES

No federally or state-listed threatened or endangered species are identified or anticipated to occur within the boundaries of the Mystic Piers site (Lincoln 1993). Although common terns have been observed nesting within Boston Harbor, no evidence of nesting was present at the Mystic Piers site on April 28, 1993.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources at the Mystic Piers site.

SOCIO-ECONOMIC/LAND USE

The inlet between the Mystic Pier No. 1 and Pier 49 is no longer used for cargo handling at Massport's Moran Terminal in Charlestown. Charlestown is a neighborhood within the City of Boston. Recreational vessels docking here in the late 1970s were removed to accommodate shipping activity. The recreational docking has not been reinstated even though the port-related shipping activity ceased to operate in the inlet. There are no residential areas abutting this property. The closest residential neighbors are across the Little Mystic Channel in the Charles Newtowne complex and in the former Navy Yard.

Charlestown, with a population of 14,731, is a dense residential community surrounded by industrial land use on the north and south edges. To the southeast, the former Boston Naval Shipyard has been redeveloped into a mixed use complex including residences, institutions, shops, offices and recreational facilities. The population of Charlestown is 95% white. From 1980 to 1990 the population shifted with a reduction in the percentage of children

and an increase in the 25-44 year age group. This reflects the new condominiums and apartments constructed in the Navy Yard and along Main Street. The median family income is $41,638.

2.3.1.2 Revere Sugar

The site is depicted on Figure A1-10.

SEDIMENT CHARACTERISTICS

Benthic samples from the interior portions of the site revealed the sediments to be anoxic silts with an oily sheen. At the mouth of the site there was a thin oxygenated layer overlaying anoxic black silts. No samples were collected within the site boundaries for sediment characterization, but Stations 1 and 2 sampled along the Mystic River berth at Revere Sugar (Appendix C of the EIR/S) represent probable sediment conditions. Contaminant loads in these sediments were generally high: Category II levels of chromium and copper; Category III levels of arsenic, lead, zinc and PCBs; high levels of total PAHs (18-44 ppm) and total petroleum hydrocarbons. Individual PAHs exhibiting particularly high values (>5 ppm) were pyrene, phenanthrene, fluoranthene and chrysene. TOC values (3-3.6%) indicate that the potential for bioaccumulation is high.

WATER QUALITY AND CIRCULATION

Tidal flow and land-based discharges to the Mystic River influence the water quality of the Revere Sugar site, which is classified as Class SB waters. Dissolved oxygen experiences August Effect fluctuations at this site.

Circulation within the Revere Sugar site is governed by tidal flow and physical structures. The northeast corner of the site is likely to experience reduced flows or eddies during flood tide since the eastern boundary of the site is perpendicular to the primary flow. Similarly,

the northwest corner would experience reduced flows or eddies during ebb tides. The pilings across the mouth of the site interrupt linear flow and can reduce current speed, enhancing the likelihood of sediment deposition. The even more numerous pilings along the western and southern edges of the site create the same effect in these areas.

AQUATIC RESOURCES

Habitat conditions were examined at the Revere Sugar site on April 28, 1993. The intertidal zone is restricted primarily to vertical excursion on pilings and walls. The wooden retaining wall along the eastern boundary and the abandoned pier on the southern side supported small quantities of macroalgae (predominantly *Fucus* sp. with some green algae). Barnacles and littorinid snails were present but not numerous. The barnacle cover increased along the western pilings towards the mouth. The granite wall behind the pilings supported some algae cover (*Fucus* sp. and green algae). Barnacle cover was heaviest on the metal pilings at the mouth of the site. Mussels were observed only at the northwest corner of the site.

Breaching of the retaining wall along the southeast portion of the site has allowed erosion into the aquatic zone, creating a small intertidal zone of rubble and fine-grained sediments.

Benthic Infauna

Benthic infauna was sampled in three locations in April 1993 (Table A1-2). Nematodes accounted for >80% of the abundance at Stations RS-1 and RS-2 (98% RS-1, 84% RS-2); *C. capitata* and oligochaetes were also numerically important components of the fauna. Abundances at RS-3 were low, made up primarily of the cirratulid polychaete *Tharyx acutus* and nematodes. Freshwater insects (chironomids, collembolans) were collected in low numbers. Species richness at RS-1, near the mouth of the site, indicates that, at least seasonally, benthic infauna can be relatively diverse in this site. The polychaetes present are primarily surface deposit feeders, indicative of the stressed sediment conditions. The tube dwelling amphipod *Microdeutopus gryllotalpa*, is commonly found associated with docks, algae and mussels (Bousfield 1973).

Its presence in the infauna suggests it is present among the fouling organisms on the pilings and bulkheads. The paucity of suspension feeders (e.g., bivalves) indicate that suspended particulates or siltation rates are higher than suitable.

Sediment profile camera sampling at three locations in October 1994 revealed all sites had homogeneous muddy sediments with some pit and mound topography, suggesting a depositional environment (NAI and Diaz 1995). There was little evidence of bioturbation (infaunal tubes, burrows, and voids). The Redox Potential Discontinuity (RPD) layer, an indication of the depth to which sediments are oxidized, was located at less than 1 cm from the sediment surface. These indicators suggest considerable environmental stress to the benthic community. Benthic infauna samples collected in October 1994 contained an average of 9 taxa per 0.12 m^2, and an average of 483.2 individuals/m^2, moderate in comparison to other Inner Harbor stations (Table A1-3). Oligochaetes, cirratulid polychaetes, and nematodes were the most abundant taxa, similar to previous collections. The epifaunal amphipod *Microdeutopus gryllotalpa* and the motile sand shrimp *Crangon septemspinosa* were also collected. The benthic infauna suggest the habitat is under environmental stress, with a pioneering or colonizing successional stage of benthic community.

Lobster

An assessment of the lobster population was made in October 1994 using experimental traps. A total of 0.2 CPUE (per trap-day) of sublegal-sized lobster (<83mm or 325 in CL) and 0.1 CPUE of legal-sized lobster were collected (Table A1-7). Males were twice as common as females (NAI 1995b). Lobster CPUE was among the highest of those in the Mystic and Chelsea Rivers, but an order of magnitude lower than offshore areas such as Meisburger 2 and 7 and Boston Lightship. This is as expected, since benthic and sediment profile sampling indicated a pioneer successional state with fine grained sediments and low densities of infauna. These less-than optimal conditions may be offset by the presence of abandoned piers, which may provide shelter for lobsters.

Finfish

As with Mystic Piers, finfish are likely to utilize the Revere Sugar site for shelter from currents and predators, and for feeding. Species feeding indiscriminantly on the bottom would encounter prey. Species that prefer to browse on hard substrates would find little food. while winter flounder could spawn in this area, their preferred spawning habitat (sand) may not occur at this site. Revere Sugar is located well below the head-of-tide, and so does not provide suitable conditions for anadromous species to spawn. A fall 1994 gill net survey collected predominantly rainbow smelt along with alewife, mackerel and winter flounder (Table A1-6). Total catch was lower than other Inner Harbor, Outer Harbor, and offshore stations (NAI 1995a).

WETLAND RESOURCES

The Revere Sugar site is located within the Mystic River DPA (310 CMR 10.00). Under Massachusetts wetlands regulations, most of the site would be designated as Land Under the Ocean and have the potential to be significant to marine fisheries, storm damage prevention and flood control. This site could provide both refuge (from currents and predators) and feeding opportunities (primarily for demersal feeders). It is unlikely to provide spawning habitat for either winter flounder, as it appeared to lack sandy sediments, or anadromous species (e.g., alewife), as it is located well below the head-of-tide. Storm damage prevention and flood control are enhanced at this site by the man made boundaries, although the seawall at the southern end of the site is in disrepair and offers limited protection against exceptionally high tides. The greatest potential for storm damage prevention and flood control occurs during low tides.

Intertidal resources include a debris strewn beach in the southeastern corner and the granite walls and pilings surrounding the site. The beach could be categorized as Coastal Beach but is not significant in the DPA. No natural intertidal features exist at this site.

Under federal regulations, the entire site is categorized as Tidal Waters. This resource provides two functions not specifically identified by Massachusetts for DPAs. The fine-grained character of the sediments indicates the potential for sediment/toxicant retention and for nutrient

retention/transformation exists. Aquatic diversity/abundance is moderate at this site and appears to vary spatially, being highest at the mouth. Potential construction at this site may be more sensitive because of its location on a river that has an anadromous fish run.

WILDLIFE

Wildlife use of the Revere Sugar site is expected to be similar to that described for Mystic Piers (Section 2.3.1.1 of this evaluation).

THREATENED AND ENDANGERED SPECIES

No federally or state-listed threatened or endangered species are identified or anticipated to occur within the boundaries of the Revere Sugar site (Lincoln 1993). Although the state-listed common tern has been observed in Boston Harbor, no evidence of nesting activities of this species was seen during a site visit on April 28, 1993.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources on or within 1000 feet of the Revere Sugar site.

SOCIO-ECONOMIC/LAND USE

Revere Sugar, a site containing 6.5± acres in Charlestown, is currently under lease from Massport by the MWRA which has constructed a water transportation facility for the ferrying of construction personnel to Deer Island. Construction personnel can park vehicles on the Revere Sugar property before boarding the ferry to Deer Island. The lease for the ferry operation runs to 1998. The dock is located on the west side of the property. The property is between two industrial sites and between the Mystic River and Medford Street. Across Medford Street are residences and a cemetery. Land side access to the site from Moran Terminal is via Terminal Street to Medford Street. These streets have mixed uses.

The neighborhood closest to Revere Sugar has a very low percentage of people below the poverty line and a high median family income compared to other locations in Charlestown.

2.3.1.3 Amstar

The site is depicted on Figure A1-11.

SEDIMENT CHARACTERISTICS

Benthic samples collected at Amstar contained odorless, grey silty sediments. No chemical analyses were performed on sediments from the Amstar site, but Station 3 from the Revere Sugar berth was located approximately 300 feet from the mouth of the site and is assumed to be representative of on-site conditions (see EIR/S Section 2.2). That station had a 73% silt-clay component (Category III). Chromium, copper and nickel all occurred at Category II levels; arsenic, lead, zinc and PCBs were Category III concentrations. Total PAHs were among the highest (46.41 ppm) observed during the 1992 berth area sampling. Benzo(b)fluoranthene, benzo(k)fluoranthene, fluoranthene and pyrene each contributed more than 5 ppm to the total concentration. Total petroleum hydrocarbons were 3540 ppm. Total organic carbon was 6.6%, among the higher values observed during the berth sampling, suggesting that potential for bioaccumulation of contaminants is lower at Amstar than other sites in Boston Harbor. Zinc and PAH uptake may be exceptions to this generalization, as these constituents were found at higher levels at Revere Sugar Station 3 than at other berths.

WATER QUALITY AND CIRCULATION

In general water, quality at this site is expected to be similar to conditions in the Mystic River since there are no obstructions to flow. Again, the water quality classification is Class SB. The character of the sediments observed within this site suggest that it may experience the late summer hypoxia (August Effect). Water quality on the site may also be influenced by two discharges on the southern and western banks which are most likely minor discharges consisting of stormwater. There is also a NPDES discharge from Cambridge Electric in the vicinity of the Amstar site (Menzie-Cura and Assoc. 1991).

Amstar opens directly on the Mystic River with no obstructions. Like Revere Sugar, the northeast corner of the site may experience reduced flows or eddies during flood tides as currents are diverted around the end of the wharf. This phenomenon would occur during ebb tides at the northwest corner. The pilings supporting the eastern wharf and the floating dock slow currents and contribute to sedimentation under the wharf.

AQUATIC RESOURCES

There are three types of intertidal habitat that occur at the Amstar site. Pilings and vertical seawalls along the eastern side provide hard substrate that has been colonized by barnacles, mussels and green algae. Beneath the ramp to the floating dock is a small, gently sloping gravel-cobble beach. The cobble support green algae. The rest of the south boundary is a rip-rap slope comprised of boulders that are heavily covered with *Fucus* sp. There is little *Fucus* sp. on the western rip-rap slope except at the mouth of the site. Along the western boundary barnacles and periwinkles (*Littorina* sp.) were numerous; green algae was present above and below the barnacle zone.

Benthic Infauna

Most of the site is submerged continuously. Differences in species composition at the two sampling locations visited in April 1993 (Table A1-2) may reflect differences in circulation, exposure and adjacent substrate conditions. Species present at Station AM-1 (dominants: nematodes, *Polydora cornuta*, oligochaetes) are typically abundant harbor-wide. Total abundance ($18,287/m^2$) at AM-1 was moderate relative to other areas sampled. Station AM-2 supported low abundances of several species, two of which (*Crangon septemspinosa* and harpacticoid copepods) are motile. Sediment at this station was gelatinous, with an oily sheen.

Sediment profile camera sampling at three sites in October 1994 showed all had homogeneous muddy sediments with some pit and mound topography, suggesting a depositional or low energy habitat (NAI and Diaz 1995). The RPD layer was within 1.0 cm of the sediment

surface, suggesting limited oxygenation of the sediments. There were few indicators of bioturbation, such as the presence of infaunal tubes, burrows, and voids. Benthic samples from one of the sites located near the 1993 sampling station AM-1 revealed abundance levels that were the highest of all Inner Harbor stations (1,912.5/m^2 Table A1-3) but an order of magnitude lower than 1993 sampling at AM-1 (Table A1-2). The dominant taxa were opportunistic polychaetes (*Polydora cornuta, Streblospio benedicti)* and nematodes, similar to AM-1; together these three taxa composed 85% of the infaunal population. The benthic community seems to be one under environmental stress, characterized by pioneering or colonizing benthic infauna.

Finfish

Finfish could utilize this area for refuge from predators, particularly among the pilings at any tide and among the *Fucus* sp. of the southern boundary during high tides. The entire site could provide refuge from peak currents due to its orientation perpendicular to the channel. Anadromous fish could use the site for this purpose. Subtidal regions could provide food resources for demersal browsers. Intertidal food resources are limited except for fish that browse green algae.

The Amstar site does not provide spawning habitat for anadromous species as freshwater input is limited to three drainage pipes. Winter flounder spawning opportunities are limited since the site's sediments are not sandy.

WETLAND RESOURCES

Amstar is located within the Mystic River DPA (310 CMR 10.00). The site is primarily Land Under the Ocean, under Massachusetts regulations, and is considered to be significant to marine fisheries, storm damage prevention and flood control. As described under Aquatic Resources, the Amstar site could provide both refuge (from predators and currents) to many fish species and feeding opportunities (primarily demersal species). It is unlikely to provide important spawning habitat.

Man-made features at Amstar were designed to contribute to storm damage prevention and flood control. Surrounding land elevations are several feet above mean high water. The rip-rap slopes along the southern and western boundaries are effective in dissipating currents and waves.

The intertidal area under the floating dock ramp could be categorized as Coastal Beach, but is not significant in the DPA.

The entire site is classified as Tidal Waters, under federal regulations. The fine-grained sediments found at this site, in conjunction with nearby sediment sampling, suggest that this site has the potential for sediment/toxicant retention and for nutrient retention/transformation. Benthic fauna were moderate in abundance and diversity compared to other sites examined. As anadromous fish species are known to transverse the Mystic River, it is possible that Amstar could be used by them as well.

WILDLIFE

Wildlife use of the Amstar site is expected to be similar to that described for Mystic Piers site.

THREATENED AND ENDANGERED SPECIES

No federally or state-listed threatened or endangered species are identified or anticipated to occur within the boundaries of the Amstar site. The state-listed common tern has been observed to nest in Boston Harbor. No nesting activities were observed during field investigations on this site on April 28, 1993.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical and archeological resources on or within 1000 feet of the Amstar site.

SOCIO-ECONOMIC/LAND USE

Amstar is an industrial site containing approximately 20 acres in Charlestown. It is currently available for sale, although there are several industrial tenants. One tenant runs a sand and gravel operation and uses the dock for material transfer. The site is in the City's Maritime Economy Reserve Zone which is geared to water dependent activities. It is surrounded by industrial uses to the east and west. Across Medford Street from the site are residences and a park. Access to Amstar is the same as that to Revere Sugar. Demographic characteristics are similar to those described for Revere Sugar.

2.3.1.4 Cabot Paint

The site is depicted on Figure A1-12.

SEDIMENT CHARACTERISTICS

Benthic samples collected at Cabot Paint contained odorless, gray silty sediments. No chemical analyses were performed on sediments from Cabot Paint site, but Station 1 of Eastern Minerals was located approximately 2000 feet from the Cabot Paint site (see Section 2.2 of the DEIR/S). This station had a 66.5% silt-clay component; arsenic, chromium, lead, mercury, zinc and PCB concentrations all occurred at Category II levels. Total PAHs occurred at Category III levels (11.38 ppm), and benzo(b)fluoranthene contributed 3.67 ppm to the total concentration. Total organic carbon was 3.6%, suggesting that some bioaccumulation of contaminants may likely occur.

The ACOE conducted chemical sampling in 1986 (ACOE 1988) at eight (8) stations (A through H) in Chelsea Creek. Station G was located in the vicinity of the Cabot Paint site. It is assumed for this level of site evaluation that the chemical constituents at Station G should be similar to that of the Cabot Paint site. Station G had a sandy organic clay composed of 68% fine grained material with a moderate chemical oxygen demand (102,000 ppm). The only contaminant detected in high concentrations was lead at 283 ppm (Category III). Levels of mercury (1.14 ppm), zinc (276 ppm) and chromium (185 ppm) were present at Category II.

WATER QUALITY AND CIRCULATION

The Chelsea Creek is classified as SB waters by the MADEP. Cabot Paint opens directly into the Chelsea Creek, but the wooden pilings on the north of this site slow currents and contribute to some sedimentation in the vicinity of the pilings.

Dissolved oxygen readings collected in April 1993 ranged from 8.6 - 9.0 mg/L at water temperatures ranging from 6.6-8.2°C. Salinity data collected on that date ranged from 22.6-28.4 ppt at low tide, indicating the influence of freshwater inputs.

AQUATIC RESOURCES

The intertidal habitats within the Cabot Paint site vary and include 1) a sloping rip-rap embankment on the north side, 2) gravel beaches on the northeast and northwest sides, 3) the wooden pilings on the north side, 4) a wooden bulkhead and concrete slab on the northwest side, 5) an abandoned boat ramp on the northwest end, and 6) abandoned barges and boat on the northwest end. Microalgae cover (*Fucus* sp. and green algae) varied throughout the site's intertidal areas. Limited cover was observed on the rip-rap, while approximately 40% of the gravel beach was covered. The abandoned boat ramp was also covered with *Fucus* sp. The wooden pilings were completely covered with barnacles and *Fucus* sp. and the wooden bulkhead had some of these species.

Benthic Infauna

The composition of the benthic infauna from samples collected in April 1993 is shown in Table A1-2. The two sampling locations may reflect the differences in substrate conditions, circulation, and exposure. Station CP-1 was located in the vicinity of the submerged pilings, where the most abundant species were Oligochaeta, *S. benedicti*, and Nematoda. The total percentage composition of these three species was 59% at Station CP-1. Total abundance at this station (of 9,202 individuals/m^2) was moderate when compared with the other areas sampled. At station CP-2 (located in an open area between the pilings) the most abundant species were *S. benedicti* and Nematoda. This station had a total abundance of 3,354/m^2, low when compared with the other stations. The total percentage composition of these three species was 96% at Station CP-2. Species richness at both stations was low (5-9).

Sediment profile camera sampling was conducted at three stations within the Cabot Paint site (NAI and Diaz 1995). Silty sediments with an RPD layer located at less than 1 cm from the sediment surface occurred at all three sites. These parameters indicate a low-energy habitat with reducing conditions near the sediment surface. Microalgal mats were observed at the sediment interface at the southern edge of the site (Station 1) and at one of the stations in the central portion of the site (Station 2). There was no indication of infauna inhabiting the sediment surface or at depth. A benthic sample from the southwestern part of the site collected one taxon. The opportunistic polychaete *Polydora cornuta* was the only organism collected, with an abundance of 25/m^2. Results indicate this was one of the most depauperate areas of the Inner Harbor (Habitat II, Table A1-3). Mound and pit topography was observed in the southeastern portion of the site, indicating a low energy environment. Evidence of bioturbation (infauna tubes, burrows) occurred only in the central and northern portion of the site. A total of 6 taxa were collected in the 0.04m^2 sample (Habitat III, Table A1-3). Opportunistic polychaetes *Polydora cornuta* and *Streblospio benedicti* were the most abundant taxa, and composed two-thirds of the total abundance. The total number of organisms, 375/m^2, was low in comparison to other Inner Harbor Stations. All abundances in 1994 were an order of magnitude lower than those observed in 1993 (Table A1-2).

Finfish

The ACOE NED collected finfish samples by gillnet in July and November, 1986 during a 48-hour effort on two different sampling days in the Chelsea Creek. The dominant finfish species found in the July sampling effort were rainbow smelt and alewife. In the November sampling effort, no fish were caught. Given the limited amount of data for comparison, no real conclusions can be drawn at this time. Finfish could use the wooden pilings and *Fucus* sp. for shelter from predators during high tide. The sandy substrate in the Chelsea Creek may provide spawning habitat for winter flounder (ACOE 1988).

WETLAND RESOURCES

Cabot Paint is located within the Chelsea River DPA and primarily contains Land Under the Ocean, as defined under Massachusetts Wetlands Protection regulations (310 CMR 10.00). Land Under the Ocean is considered to be significant to marine fisheries, storm damage prevention and flood control. The sloping rip-rap embayment on the north side of the site was designed for storm damage prevention and control. The gravel beaches could be categorized as Coastal Beach, but this designation is not significant in the DPA.

Many species of marine fishes, including anadromous fish, may inhabit DPAs. Anadromous fish such as rainbow smelt and alewife are known to traverse the Chelsea Creek. As described in the Aquatic Resources section, the Cabot Paint site could provide both shelter from predators and feeding opportunities for these fish species. This site may also provide spawning habitat for winter flounder.

The entire site is classified as Tidal Waters under federal regulations. The fined-grained sediments and the results of the samples analyzed indicate that this site has the potential for sediment/toxicant affinity and nutrient retention. Benthic infauna species diversity was low-moderate and species richness was low at this site.

WILDLIFE

On-site wildlife resources appear limited, and very similar to the Mystic Piers site.

THREATENED AND ENDANGERED SPECIES

No federally or state-listed threatened or endangered species are identified or expected to occur within the vicinity of the Cabot Paint site.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no sites or structures of historical, architectural or archeological significance as defined by MHC or the National Historical Preservation Act, as amended.

SOCIO-ECONOMIC/LAND USE

This site, containing 6.5± acres off Marginal Street in Chelsea, is a mixed use parcel, fully occupied by industrial tenants and a major car rental storage facility. The current owner has demolished some of the industrial buildings on site and adapted the remaining buildings to support several industrial uses. The wooden bulkhead along Chelsea Creek has deteriorated and currently poses navigation problems for vessels traversing Chelsea Creek. A commuter ferry service to Boston operated briefly out of this location during 1990 in an effort to reinstate ferry service from this site. The service was discontinued.

The City of Chelsea evolved from a summer resort community to a residential suburb of Boston. A major fire in 1908, in which over 17,000 residents were left homeless, changed the landscape permanently. The Chelsea which emerged from the fire was primarily commercial with manufacturing and shipping facilities. Several of the industries have closed in recent years succeeded by service and distribution operations. The population of Chelsea is 28,710 and is 70% white with a high percentage also reporting Hispanic origin. The median family income is $29,039. High end residential use has been developed on property surplused by the military, contrasting with more modest housing in densely populated sections of Chelsea.

Access to this site over land is via I-93 to the Tobin Bridge to Chestnut Street, and from Chestnut south to Williams Street, then east on Williams to Marginal Street.

2.3.1.5 Little Mystic Channel

The site is depicted on Figure A1-13.

SEDIMENT CHARACTERISTICS

No samples were collected within the site boundaries for sediment characterization, but Stations 2 and 3 at the Mystic Pier sites are in close proximity to the Little Mystic Channel and should represent probable sediment conditions. The sediment texture was predominately fine grained with a range of 76.3% - 78.4% silt-clay (Category II). Bulk sediment metals test results showed that at Station 2, arsenic, chromium, copper, lead, mercury, and zinc all occurred at Category II levels (Appendix C). At Station 3, arsenic, lead and zinc were found to be Category III, and cadmium, chromium, copper, and mercury were found to be Category II concentrations. Total PAHs ranged from 5.23 and 29.75 ppm at Stations 2 and 3 in Mystic Pier 1. Station 3 contained the highest levels of metals of the three stations at this site. At Station 3, benzo(a)-anthracene and benzo(a)pyrene, chrysene, fluoranthene and pyrene were present in concentrations above 4 ppm. But at Station 2, only fluoranthene was above 5 ppm. At Mystic Pier 1, total petroleum hydrocarbon concentrations were among the highest observed during the 1993 berth area sampling. At Mystic Pier 1, there have been approximately twelve minor oil spills (U.S. Coast Guard, Marine Safety Office, letter dated May 13, 1992). This may have influenced the concentration of PAHs and TPHs at this site. PCBs were present at Category III concentrations at Stations 2 and 3. Total organic carbon ranged from 2.1-4.9% at both stations. This is an average value, indicating that there are moderate levels of food resources for benthic deposit feeders, suggesting that some bioaccumulation of contaminants may be occurring.

WATER QUALITY AND CIRCULATION

The water quality of the Little Mystic Channel is influenced by tidal exchange, the six discharge pipes that were observed on the north side of the site, and a Combined Sewer Overflow (CSO). These storm drainage pipes add urban runoff pollutants (e.g., oil and grease,

detergents etc.) into the Channel. There is one CSO, the Chelsea Street Extension outfall, which discharges directly to the Little Mystic Channel on the south shore. The currents in Little Mystic Channel are primarily tidally driven. The Little Mystic Channel is classified as SB water by the MADEP. Dissolved oxygen readings collected in April 1993 ranged from 9.0-9.4 ppm. As temperatures peak in August, available dissolved oxygen levels diminish within Boston Harbor and cause a corresponding depression in biological activity at the sediment water interface (August Effect). This oxygen depletion contributes to a significant faunal depletion on a cyclic basis (Hubbard and Bellmer 1989). Salinity data collected in April 1993 ranged from 16.8-28.9 % at low tide, indicating the influence of freshwater inputs to the Harbor. Little Mystic Channel flows directly into the Main Ship Channel, but the Mystic-Tobin bridge pilings slow currents and contribute to some sedimentation in the vicinity of the pilings.

AQUATIC RESOURCES

The intertidal habitats within the Mystic Channel vary and include, 1) vertical granite walls on the north and south side which contain approximately 80% *Fucus* sp. and a one-inch layer of barnacles; 2) sloping rip-rap embankment on the west side which is covered with *Fucus* sp. and green algae; 3) wooden bridge pilings on the eastern side which were covered with periwinkles (*Littorina* sp.), barnacles and green algae; 4) submerged logs and boat on the north side; 5) a metal bulkhead which was covered with *Fucus* sp., heavy barnacle settlement, and some mussels approximately 50 feet from the bridge; 6) a sandy/gravel beach on the south side which was sparsely covered with green algae; and 7) a rock ledge beach on the north side which was covered with *Fucus* sp.

Benthic Infauna

Composition of the benthic infauna at the site in April 1993 is shown in Table A1-2. The four sampling locations may reflect the differences in substrate conditions, circulation and exposure. Station LMC-2, located in the vicinity of the sloping rip-rap embayment, was most diverse in terms of species composition. The total abundance of organisms was 27,907 individu-

als/m^2 at this station, a moderate level relative to other harbor areas sampled. Oligochaeta was the dominant taxon and had an abundance of 13,717/m^2. Station LMC-1 supported low abundance of two taxa, *Tharyx acutus* (86/m^2) and *S. benedicti* (43/m^2) at extremely low levels compared to all the other sites for these taxa. Station LMC-3 supported a low abundance of 10 taxa, the most abundant being Nematoda and *S. benedicti*. Station LMC-4 had a low abundance of six taxa, the most abundant being Nematoda. The sediment samples collected at this site for benthic infauna observations were fine and grayish-black in color with a mild sulfur odor.

Sediment profile camera sampling in 1994 at four locations showed homogeneous mud sediments throughout the area with evidence of mound and pit topography, indicating a depositional environment (NAI and Diaz 1995). The depth to the RPD layer ranged from 0.2-1.0 cm below the sediment surface, suggesting varying degrees of sediment oxygenation, and thus environmental perturbation, in the area. There were low numbers of infauna tubes at the sediment surface, but no other indicators of bioturbation. Benthic samples collected in October 1994 revealed a depauperate benthic community. Numbers of taxa (3/0.12 m^2) and total abundance (16.6/m^2) were among the lowest observed in the Inner Harbor (Table A1-3). The surface dwelling bivalve *Mulinia lateralis*, the hydrozoan *Obelia* sp., and amphipod *Gammarus lawrencianus* were the only species that were collected; none of these species was collected in the 1993 study (Table A1-2).

Lobster

A total of 0.6 sublegal lobsters and 0.6 legal-sized lobsters were collected per trap-day in the fall collection in 1994 (Table A1-7). The total CPUE was higher than that recorded from the Mystic and Chelsea Rivers, similar to that at Harbor Stations such as the nearby Inner Confluence and Logan 02, but much lower than offshore stations such as Meisburger 2 and 7. Males were more abundant than females (NAI 1995b). Little Mystic Channel had the highest recorded legal lobster catch (0.6 per trap day, all males) of all stations sampled. This may be a result of the presence of abandoned piers, which may provide shelter. Abundances of invertebrates were low to moderate, and were composed mainly of small worms such as oligochaetes and nematodes, which are not preferred lobster prey items.

Finfish

The dominant finfish species recorded in the Main Ship Channel include winter flounder, rainbow smelt, and alewife (ACOE, NED 1988). There probably is movement of at least some of these species in and out of the Little Mystic Channel. Gill net collections in October 1994 in Little Mystic Channel captured low numbers of rainbow smelt, Atlantic tomcod, alewife, cunner and butterfish (Table A1-6). Trawls in the Inner Confluence area made at the same time collected moderate catches of winter flounder, windowpane, and rainbow smelt (Table A1-4). Finfish could use the wooden bridge pilings, submerged logs and boat and *Fucus* sp. for shelter from predators during high tide. The predominant sandy/silt sediment present at this site provides suitable habitat for winter flounder. There was also a fair supply of *C. capitata* in part of the channel in 1993 (1892/m^2 at Station LMC-2); these are consumed by winter flounder according to Haedrich and Haedrich (1974). However, 1994 sampling showed little evidence of food resources for higher trophic levels.

WETLAND RESOURCES

Little Mystic Channel is located within the Mystic River DPA (310 CMR 10.00). The site is primarily Land Under the Ocean, under the State regulations, and is considered to be significant to marine fisheries, storm damage prevention and flood control. The vertical granite wall on the north and south side, together with the sloping rip-rap embayment on the west of the site, were all structures designed for storm damage prevention and flood control. Significance to marine fisheries is discussed above.

Anadromous fish are known to traverse the Main Ship Channel and there may be movement into the Little Mystic Channel. As described in the Aquatic Resources section, the Little Mystic Channel could provide both shelter from predators and feeding opportunities for several fish species. This site might also provide spawning habitat for anadromous species.

The entire site is classified as Tidal Waters under federal regulations. The fined-grained sediments results of the samples analyzed at Mystic Pier, which is in close proximity to Little Mystic Channel, indicate that this site has the potential for sediment/toxicant affinity and nutrient retention. Benthic infauna were moderately diverse in species composition at one station and showed low abundance at the other three stations sampled at this site.

WILDLIFE

Wildlife use in the Little Mystic Channel is expected to be similar to that described at the Mystic Pier site.

THREATENED AND ENDANGERED SPECIES

No federally or state-listed threatened or endangered species are identified or expected to occur within the vicinity of the Little Mystic Channel.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources at the Little Mystic Channel site.

SOCIO-ECONOMIC/LAND USE

This little-used channel in Charlestown is surrounded by a mixture of land uses including residential, recreational and maritime-industrial. Adjacent to the site are the Charles Newtowne public housing project, a City of Boston playground, the Charlestown High School recreational field and Mystic Pier 1. The channel provides a visual buffer between the residences to the south and the marine terminal to the north. A public boat ramp is located on the north side of the channel. However, this ramp has not received the use anticipated when it was installed in the early 1970s. Demographic characteristics of this area are similar to those described at the Mystic Pier site.

Marine access to this site is constrained by the 12 foot vertical clearance under the Little Mystic Channel Crossing at the mouth of the channel. Landside access to this site is via Terminal Street from Moran Terminal.

2.3.1.6 Reserved Channel

The site is depicted on Figure A1-14. Two areas in the Reserved Channel are being evaluated as candidate sites for disposal, Areas A and B, respectively.

Area A—This area is located at the mouth of the inlet on the inner side of the bridge (away from open water). It is approximately 8.9 acres in size with water depths ranging from 6 to 12 feet MLW. A floating dock and the yacht club are located in this portion of the site. The passage under the Summer Street Bridge is 40 feet in width. Northwest of the bridge is a vertical granite wall approximately 50 feet in length. Continuing west-northwest, the granite wall is replaced by a metal bulkhead. On the far northwestern end of the bulkhead are some abandoned wood pilings and an old floating dock. On the southwestern side of the site from the bridge is a sloping rip-rap embankment for approximately 50 feet. From this rip-rap toward the neck are discarded concrete slabs and trash material. West of the trash material are wooden pilings and behind the pilings is a vertical granite wall.

Area B—This portion of the site extends from the neck on the northwest toward the tip of the peninsula. It is approximately 7.7 acres in size with water depths ranging from 0 to 16 feet. A steel bulkhead extends for approximately 75 feet. Continuing along the western tip and along the southwestern side of the inlet is a sloping rip-rap embankment. Between the bulkhead and the rip-rap is a pile of rubble. On the southwestern side toward the neck the rip-rap is replaced by a granite wall, which is fronted by a rocky beach. In front of the rocky beach are one or two sunken boats and some abandoned pilings. In the middle of the tidal area is a floating lobster pot dock.

SEDIMENT CHARACTERISTICS

Benthic samples collected at the Reserved Channel contained odorless, gray-black clay/silt sediment. No chemical analyses were per formed on these sediments, but Station 3 of

the Boston Edison Intake was located approximately 1000 feet from the Reserved Channel Area B (see Section 2.2 of the EIS). This station had a 66.2% silt-clay component (Category II) and indicated PCB and PAH levels at Category III. Fluoranthene, ideno(1,2,3-cd)pyrene, and pyrene contributed more than 50% to the total PAHs concentrations. Cadmium, Lead, and Nickel were found at Category II at this station. Total organic carbon was 13%, the second-highest value of all the sites analyzed for TOC. This indicates that the potential for bioaccumulation at the Reserved Channel Area B is lower than other sites in the Boston Harbor. The total petroleum hydrocarbon at this station was 4270 ppm.

The ACOE conducted chemical sampling during 1986 at four stations (A, B, C, and D) in the Reserved Channel. Station A was located in the western end of the Reserved Channel close to Area B. At Station A an 18-23 cm core section was analyzed. It had an 18.2 cm layer of black organic clay. This upper organic clay consisted of 93% fine grain material with a moderate chemical oxygen demand (79,000 ppm). Lead was the only chemical constituent present at Category III concentrations (221 ppm). Mercury (1.48 ppm), zinc (264 ppm), chromium (186 ppm), and nickel (58 ppm) were detected at Category II levels.

PCB samples were collected at 8 stations by Boston Survey Consultants in November 1982, from the Reserved Channel west of Summer Street Bridge within Area A (MADEP-Boston Files, 1983). PCB concentrations at all eight stations occurred at Category III and ranged from 1.0-34.5 ppm.

WATER QUALITY AND CIRCULATION

The water quality of the Reserved Channel is influenced by the three combined sewer overflows (CSO) observed approximately 700 feet northwest of Pappas Street, at Summer Street, and at I Street. These CSOs can add urban runoff pollutants (e.g., PAHs, nutrients, detergents, bacteria, etc.) into the Channel. Boston Edison has a NPDES discharge pipe in the vicinity of Summer Street; the NPDES permit limits the thermal influence on surface waters in the Reserved Channel.

The Reserved Channel flows directly into the Main Ship Channel. The Summer Street bridge pilings slow and deflect currents and contribute to some sedimentation in the vicinity of the pilings.

The Reserved Channel is classified as SB Water by the MADEP. In both Areas A and B, dissolved oxygen readings collected in April ranged from 8.4-8.7 ppm and 6.8-8.9 ppm respectively. As temperatures peak in August in Boston Harbor, available dissolved oxygen levels can diminish and cause a corresponding depression in biological activity at the sediment water interface (August Effect). This oxygen depletion contributes to a significant faunal depletion on a cyclic basis (Hubbard and Bellmer 1989). Salinity data collected in April 1993, ranged from 27.0-31.2 ppt at Area A and 23.4-33.4 ppt at Area B during low tide, indicating the influence of freshwater inputs to the Harbor.

AQUATIC RESOURCES

The intertidal habitats within the Reserved Channel include:

Area A: Wooden bridge pilings and a floating yacht club dock were sparsely covered with green algae. A vertical granite wall on the northwest side of Summer Street was covered with approximately 20% of algae. A metal bulkhead on the northwest side was covered with green algae and barnacles. Sloping rip-rap embankment on the southwest side was covered with *Fucus* sp., barnacles, *Littornia* sp., and green algae. Some concrete slab and trash material was present which had no visible growth; there were some abandoned wooden pilings and an old floating dock on the far northwestern side.

Area B: A steel bulkhead on the northwest side was approximately 90% covered with barnacles. A sloping rip-rap embankment on the western tip and southwestern side was moderately covered with *Fucus* sp., *Enteromorpha* (tubular green algae), and other green algae. A granite wall on southwestern side towards the narrow neck had moderate growth of *Fucus* sp., *Ulva* sp., and barnacles. A rocky beach in front of the

granite wall was sparsely covered with *Littornia* sp., *Fucus* sp., and green algae. There were also sunken boats, abandoned pilings and a floating lobster dock present.

Benthic Infauna

The composition of the benthic infauna from 1993 collections is shown in Table A1-2. The four sampling locations may reflect the differences in substrate conditions, circulation and exposure. Stations RC-1 and RC-2 were located in Area A and RC-3 and RC-4 located in Area B.

Area A: Station RC-2 was located in the vicinity of the Granite wall on the southwestern side of Area A, had the most diversified species composition. Oligochaeta and *S. benedicti* was the two most abundant taxa (15,480/m^2 and 1548/m^2, respectively) of all the sites sampled. The total abundance was 21,156/m^2 at Station RC-2 which was moderate relative to other areas sampled. Station RC-1 supported low abundance of seven species, the most abundant being Oligochaeta (2451/m^2). Oligochaetes were moderately abundant at this site compared with all the other sites. The total abundance was 3,096/m^2 at Station RC-2, and was low relative to other areas sampled.

Area B: Station RC-3, located in the vicinity of the lobster dock, supported very low abundance of four taxa, the most abundant being *S. benedicti* (215/m^2). At Station RC-4 Oligochaeta (26,574/m^2), *Corophium insidiosum* (2580/m^2), and Nematoda (16,641/m^2) were the most abundant taxa. The first two taxa occurred in higher abundances at this site than any of the other sites sampled. The total abundance at Station RC-4 was 49,837/m^2, fairly high relative to the other areas sampled.

The sediment samples collected at this site for benthic infauna observations were odorless, clay/silt, and grayish black in color.

Samples were collected in October 1994 at one location in Area A and two locations in Area B. As there were no substantial differences among the three stations, abundances were averaged for the purpose of this assessment. A total of 1,041 individuals/m^2, representing 17 taxa in the three 0.04 m^2 samples was collected (Table A1-3). The species richness and abundance were among the highest in the Inner Harbor, although much lower than most of the stations sampled in 1993 (Table A1-2). The most abundant species were small, opportunistic polychaetes such as *Leitoscoloplos robustus* (375/m^2) and the soft-shell clam *Mya arenaria* (158/m^2); both were also collected in 1993 (Table A1-2).

Lobster

An assessment of the lobster population was made in October 1994 using experimental traps (NAI 1995b). A total of 1.4 lobsters per trap-day were collected, of which 1.2 were sublegals and 0.2 were of legal size (Table A1-7). The numbers of lobsters collected were moderate in comparison to other areas sample in Boston Harbor, higher than river habitats, but lower than offshore habitats. The wooden pier pilings may provide additional shelter for lobster. CSO outfalls may enhance nutrient concentrations, resulting in high abundances of food resources. However, the dominant benthic species were small, surface-swelling polychaetes, which are not a preferred food source.

Finfish

Gill net collections in October 1994 in the Reserved Channel were the highest of all stations sampled in Boston Harbor. An average of 96.7 fish were collected per 24-hour set, composed mainly of blueback herring and alewife (Table A1-6). Recreationally important species such as striped bass, American shad, bluefish and rainbow smelt were also collected in low numbers. These species are typical pelagic species, whose capture is more likely a random event rather than an indication of habitat value.

The dominant finfish species in the Main Ship Channel are flounder, rainbow smelt, and alewife. There may be movement of these species into the Reserved Channel. Finfish may use the wooden bridge pilings, floating dock, and *Fucus* sp. for shelter from predators during high tide. The Reserved Channel may provide spawning habitat for winter flounder, although it lacks the preferred substrate.

WETLAND RESOURCES

Areas A and B of the Reserved Channel are not located within a Designated Port Area (310 CMR 10.00). The site is primarily Land Under the Ocean under Massachusetts Wetlands Protection regulations (310 CMR 10.00); this classification is considered to be significant to the protection of marine fisheries, which are discussed above. Nearshore areas of Land Under the Ocean such as Areas A and B are likely to be significant to storm damage prevention and flood control. The vertical granite wall and bulkhead, together with the sloping rip-rap embankment at the site, were all structures designed for storm damage prevention and flood control. Nearshore areas of Land Under the Ocean also provide important food for birds; for example, waterfowl can feed on the algae. The sloping rip-rap embankment and the rocky beach (Coastal Beach) at this site were covered with algae.

The entire site is classified as Tidal Waters under federal regulations. The fined-grained sediment and chemical levels in the samples analyzed show that this site has had an affinity for toxicant and nutrient retention. Benthic infauna were moderately diverse in species composition at two stations and showed low abundances and species richness at the other two stations sampled at this site.

WILDLIFE

Wildlife use at the Reserved Channel is expected to be similar to that described for Mystic Piers (Section 2.3.1.1 of this evaluation).

THREATENED AND ENDANGERED SPECIES

No federally or state-listed threatened or endangered species are identified or expected to occur within the vicinity of the Reserved Channel.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources at the Reserved Channel site.

SOCIO-ECONOMIC/LAND USE

This channel is generally surrounded by industrial and office uses in South Boston. There is a sewer outfall at the southerly end of the Channel which would require relocation if this area were to be filled. There is a yacht club immediately adjacent to the Summer Street Bridge, and a passive water viewing area has been created for the general public to use on the west side of the channel. This viewing area is not 6(f) land because it was not purchased or improved with funds from the Land and Water Conservation Act (16 USC 460). As noted earlier there is a floating lobster pot dock in the middle of Area B; the extent of its use is not known.

While the South Boston peninsula was settled early in Boston's history, much of the land area between the subject site and Boston Harbor was created by filling the tidal flats. The filled land supported maritime shipping and railroad terminal uses. The area to the south of the channel has traditionally been a densely populated, predominantly residential neighborhood. The population of South Boston is 29,464 of which 96% is white. The median family income in the subject area is $34,200.

Marine access to this site is restricted by the vertical clearance on the Summer Street Bridge over the Channel. That clearance is only 6 feet at high tide. The most direct landside access would be I-93 south to Summer Street and then east to the Reserved Channel.

2.3.2 Environmental Consequences of Use of Shoreline Sites for Dredged Material Disposal

Two different disposal scenarios have been evaluated for each of the shoreline sites. The former pier areas (Amstar, Cabot Paint, Mystic Piers and Revere Sugar) and Little Mystic Channel could be filled either to mean low water (including cap) or to fastland. Reserved Channel would be filled either only in the westernmost end (to +6 ft MLW) or west from the Summer Street Bridge (maintaining subtidal conditions in the area near the bridge). Disposal in these areas would require the construction of a bulkhead to isolate the disposal operations from the harbor waters. In the scenarios where final elevation would be mean low water, the disposed silt would be capped and then the bulkhead would be clipped off to mean low water.

For ease of presentation, the different types of impacts are discussed generically and site-specific information on shoreline sites is presented at the end of each subsection.

Direct Impacts

In either fill scenario, the dredged materials placed in shoreline sites would sequester existing sediments. Although the chemical constituents of the surface sediments at many of these sites have not been determined, areas adjacent to each site have been tested. It is likely that metals, PCBs and PAHs are elevated to undesirable levels in Amstar, Cabot Paint, Little Mystic Channel, Reserved Channel and Revere Sugar. Mystic Piers is likely to contain elevated levels of metals and PAHs. Covering these sediments would provide the benefit of preventing their reintroduction into the waters of Boston Harbor and would prevent further exposure of biota that might utilize these areas. It would not prevent reintroduction of contaminants from other sources in the partial fill scenario.

Partial fill. Under the partial fill scenario, subtidal habitat would be temporarily impacted and removed from productivity. Closure of the site would return it to aquatic habitat, but in an altered form. Both depth and substrate character would differ from existing conditions. The footprint of each site is listed on Table A1-8. The quantity of habitat affected would be the

smallest for Mystic Piers, slightly higher for Amstar and Revere Sugar, higher for Cabot Paint and substantially higher for Little Mystic Channel and Reserved Channel. The cap, probably parent material from the channel deepening, would not be suitable for colonization by benthic organisms immediately. Dense clay does not generally support benthic infauna, but this area would be likely to experience sedimentation. Once the sedimentation took place, benthic infauna typical of the Inner Harbor would colonize the area. Conversion of the site from subtidal to intertidal habitat would be unlikely to increase its benthic productivity. Reduction in depth could make the area somewhat more useful for juvenile finfish as shallower conditions have been found to provide refuge from predators in the absence of other, preferred (e.g., salt marsh, eelgrass bed) refuge. Such shallow water refuge is limited within Boston inner harbor. This area would be available during most of each tidal cycle, except for a limited period around each low tide.

Fastland. Filling the Amstar, Cabot Paint, Mystic Piers or Revere Sugar pier area to the elevation of the adjacent land would result in the permanent loss of subtidal habitat (Table A1-8). The bulkhead enclosing the dredged material would replace a portion of the hard substrate habitat presently provided by pilings and bulkheads along the interior of each site. It is not proposed to fill any of Reserved Channel to fastland.

Indirect Impacts - Water Quality Effects

Construction of the bulkhead would require driving sheetpile into the existing substrate. While this activity would suspend some of the surface sediments into the water column, the effect on water quality is expected to be minimal.

Harbor water trapped behind the bulkhead would be pumped out before disposal of silts was initiated. Once most of the water was discharged back into the harbor, the remainder would be filtered to prevent mobilization of silts from the disposal site. Because the site would be enclosed before disposal took place, individual disposal events would not impact water quality with the exception of occasional minor spills as silt was transferred from the barge to the disposal site.

Indirect Impacts - Site Stability

Long-term water quality effects could arise from two sources - dewatering of the sediments and failure of the cap or bulkhead. In the partial fill scenario, no attempt would be made to dewater the silt in place, with the exception of the consolidation that was caused by placement of the cap. In the fill-to-fastland scenario, water would be drained from the site through wicks in the bulkhead. The wicks would filter particulate material, but would not completely control dissolved contaminants from being released into Boston Harbor. The elutriate tests on surface sediments from the channels conducted by the U.S. Army Corps of Engineers provide an approximation of the levels of contaminants that could be released through the wicks. These tests showed that mercury, copper and PCBs had the highest potential of being released.

Cap failure could occur at some of the sites adjacent to active piers. Although bottom currents in the inner harbor are of insufficient speed to resuspend a sand cap and waves do not develop sufficient height to affect the substrate in the inner harbor, cargo vessels making turns, docking and departing docks use more power than when underway in the shipping channels. These same conditions could affect the long-term stability of the bulkhead, although this effect would be taken into consideration during site design. This effect has the greatest potential to occur at Amstar, Revere Sugar (these two sites are adjacent to the active Revere Sugar terminal), Mystic Piers (adjacent to Mystic Piers 2, 49 and 50, as well as the bend at the Inner Confluence), and Cabot Paint (parallel to the main channel of Chelsea Creek). Little Mystic Channel could be exposed to activities at the active Mystic Pier 1, but site geometry would allow more flexible design considerations to avoid this effect. Reserved Channel would not be exposed to the effects of propeller wash, but unless moved or modified, the four CSOs discharging into this area could affect the cap integrity. Failure of either the cap or the bulkhead would allow release of the dredged materials back into the harbor system. At a minimum, a turbidity plume would likely be evident.

Indirect Impacts - Downstream Resources

Anadromous fish spawning runs in the Mystic River would be the downstream biological resource of greatest concern for Amstar, Revere Sugar, Mystic Piers and Little Mystic Channel. The Chelsea River supports winter flounder spawning and has several small intertidal flats that would be of concern with use of the Cabot Paint site. Barring catastrophic failure of the containment structure, the likelihood of impacting these resources would be limited.

Similarly, harbor water users (e.g., lobster pounds and the New England Aquarium) would be unlikely affected by the use of these sites.

Located near the mouth of the Inner Harbor, at the head of the navigational channel, the Reserved Channel site is closer to the biological resources of the Outer Harbor than the other shoreline sites. However, except in the event of cap or bulkhead failure, it is unlikely to influence these resources. Discharge of silt from the Reserved Channel containment area could affect the intake at Boston Edison; this would be likely only in the case of failure of the cap or bulkhead.

Indirect Impacts - Biological Exposure Potential

Filling of any of the shoreline sites would be conducted in complete isolation from the waters of Boston Harbor. No pelagic or benthic organisms would be exposed to the BHNIP silt after it had been disposed in one of the shoreline containment sites. In the partial fill scenarios, the final cap would be of sufficient thickness to ensure that it would not be breached either through bioturbation or physical forces. In the fastland scenarios, the site would remain isolated from Boston Harbor waters and their associated biota for perpetuity. However, if the fastland areas were left uncovered, with a lens of water on the surface, it is likely that they would be attractive to diving birds. This could pose some risk of exposure to contaminants. Although there would be little or nothing upon which to feed, birds that attempted to forage could ingest some sediments. Others could be exposed though skin contact with the water, although this is unlikely. Although individual birds would be unlikely to attempt to feed in the containment area

for extended periods because of limited success, such an area could be attractive to birds for resting.

Other Issues

No federally or state-listed threatened or endangered species are identified or expected to occur within the vicinity of the Mystic Piers, Revere Sugar, Amstar, Cabot Paint, Little Mystic Channel or Reserved Channel sites.

The proposed project at the Mystic Piers, Revere Sugar, Amstar, Cabot Paint, Little Mystic Channel or Reserved Channel would have no effect upon any structure or site of historic, architectural or archeological significance as defined by MHC or the National Historic Preservation Act of 1966, as amended.

The disposal operations at most of the shoreline sites (Mystic Piers, Revere Sugar, Amstar and Cabot Paint) could be handled by barge transport, avoiding impact to traffic on public streets. Because of restricted passage under bridges, disposal activities at Little Mystic Channel and Reserved Channel would require transfer of material from barges to trucks and transport on public streets. Selection of Amstar for disposal of BHNIP materials would displace the MWRA water transportation facility and potentially displace a sand and gravel operation on the site. Use of the Cabot Paint site would tend to aggravate the existing concerns about navigation in that portion of the Chelsea River. Disposal of dredged materials in the upper Reserved Channel would require the relocation of existing CSOs and could interfere with an existing yacht club. There are no current uses of the Mystic Piers, Revere Sugar or Little Mystic Channel sites that would be affected by use of these sites for dredged material disposal.

2.4 SITE EVALUATIONS: IN-CHANNEL AREAS AND BORROW PITS

2.4.1 Existing Conditions

2.4.1.1 In-Channel Areas

The In-Channel disposal scenario is simply the placement and capping of dredged material within the channel/tributary from which it had been dredged.

Silt and sediments would be dredged from each channel, placed on a barge, a deeper trench would then be dug in the channel, and the silt and sediment placed within the trench and capped. The proposed use and methods are described in more detail in Section 3.0 of the EIR/S. Each channel/tributary would contain its own silt material and be capped therein. As the environmental resources and consequences for this disposal alternative are the same as for the dredging site, the existing conditions of the water and sediment quality, biological and socio-economic environment in each site are described in the Section 3.0 of the EIR/S.

2.4.1.2 Spectacle Island Confined Aquatic Disposal (CAD)

The site is depicted on Figure A1-15.

SEDIMENT CHARACTERISTICS

The CA/T project examined sediments in and near this area with ponar grabs and borings to characterize the surficial material and underlying sediments (Cortell 1990b) (Table A1-9). Surface sediments tended to form broad areas of uniform grain size. Fine sand (with some silt) predominated in a 500-foot band following the northeastern shoreline to about mid-island, 300 feet beyond MLW and recurred beyond the mussel bed several hundred feet further south.

From mid-island and beyond the southern sand band, sediments were primarily silty, with some clay. Seaward of these areas, surface sediments were clay with some silt (Cortell 1990b).

Bulk sediment analysis of borings indicated that surface and near surface sediments offshore of the eastern shoreline of Spectacle Island were generally free of contaminants (Cortell 1990b). Three of the five borings (ST1-7, ST1-9, ST1-11; Table A1-9) in the area proposed were classified as Category I under the Massachusetts criteria for the classification of dredged materials, although volatile solids at ST1-11 were within the Category II range (7-9 ppm) (Table A1-9). Elevated levels of arsenic, a naturally occurring metal in New England soils, caused surface sediments at ST1-8 and ST1-12 to be classified as Category II (12-20 ppm); subsurface concentrations of arsenic resulted in Category III (>20 ppm) classification of sediments below one foot at ST1-8 (Appendix C-1; Table 2 of the Sampling Plan). Because of these findings, the proposed disposal location has been designed to involve only those areas where Category I sediments were recorded (see Figure A1-15).

WATER QUALITY AND CIRCULATION

The hydrodynamics around Spectacle Island were examined for the CA/T (Cortell 1990b). Circulation is dominated by tidal currents, affected by the distribution of islands and channels in the Outer Harbor. Ebb tide currents passing the east side of Spectacle Island can reach 0.6 knots on spring tides, while spring flood tides reach 0.4 knots. The broad shallow subtidal area off the eastern shore diverts currents toward the channels (President Roads to the north; Sculpin Ledge to the southeast). The area proposed for the CAD is subjected to lower tidal currents created by eddies. Waves in the vicinity of Spectacle Island are primarily storm driven. The maximum fetch for Spectacle Island is 7.1± nautical miles. Wave energy for the area was calculated for the Massport Logan Inclined Safety Area (ISA) EIR for storms with wind velocities from 10 to 50 knots. The wave breaker height near Spectacle Island ranged from 0.09 to 2.60 feet with wave powers of 0.1 to 412.9 ft-lb/sec.

The waters in the vicinity of Spectacle Island have been classified as Class SB waters. This classification protects saline waters for the propagation of marine life, primary and secondary

contact recreation and shellfish harvesting with depuration. Water quality in the Outer Harbor area historically has been influenced by raw sewage discharges, CSOs, various industrial discharges, urban runoff and the pollutants flowing from the Inner Harbor system. However, as upgrades to treatment processes are completed, water quality in the Harbor has, and will continue to improve.

AQUATIC RESOURCES

Benthic Infauna

Benthic resources east of Spectacle Island were examined for the CA/T project (Stations 6, 7, 9, 10; Cortell 1990b). Comparison of stations (through cluster analysis) indicates that these stations were similar in terms of species structure (Battelle 1988). The faunal community was dominated by the tube dwelling amphipod *Ampelisca abdita* (37%) and the gastropod *Nassarius trivittatus* (20%), reflecting relatively clean, sandy sediments. Nephtyid polychaetes (*Nephtys caeca* and *N. ciliata*) were also numerically important at these stations. Total abundance (ranging from 653-3107/m^2) was low compared to other sandy areas (Massachusetts Bay) and silty areas of the Inner Harbor (up to 241,230/m^2). Station 10, off the northeast shoreline of Spectacle Island, had the highest abundance and number of taxa of the 11 stations sampled around the island. Larger fauna were evaluated qualitatively along transects swum for lobster investigations (Transects 3 and 4 reached the shoreward portions of the proposed CAD site; Cortell 1990b). In addition to *Nassarius* sp. and *Ampelisca* sp. the offshore portions of these transects supported nereid worms (sand worms), *Pagurus* sp. (hermit crabs), *Panopeus* sp. (mud crabs) and *Cancer irroratus* (rock crabs).

Sediment profile camera sampling on the east side of Spectacle Island in the area proposed for disposal revealed a well-developed benthic community intermediate between a pioneering or colonizing and equilibrium stage (NAI and Diaz 1995). The majority of the stations had silt sediments. The depth of the RPD layer ranged from 1.5-5 cm, indicating sediments were well oxygenated. The sediment surface was overlain with mats composed of *Ampelisca* amphipod tubes in varying stages of succession. Benthic samples showed that *Ampelisca* sp. was the

dominant taxon, composing 56% of the total abundance. (Habitat I, Table A1-10). Secondary dominants included *Aricidea* (*Acmira*) *catherinae* (15%) and *Polydora cornuta* (7%). Total abundance, 64,870.6/m^2, representing 59 taxa, was intermediate among the Outer Harbor locations that were sampled, but at least an order of magnitude higher than that observed previously (Cortell 1990b). Slightly more than one third of the stations had silt sediments with a layer of fine sand; shell hash and gravel were also observed on the sediment interface, (indicating an erosional environment) along with *Ampelisca* sp. tube mats. In these areas, the depth of the RPD layer was closer to the surface (0.5-3.5 cm) than in other areas of Spectacle Island. Evidence of bioturbation was observed in all areas, including infaunal worms, burrows, and oxic and anoxic voids. Benthic samples revealed that *Ampelisca* sp. was the dominant taxon, composing 60% of the total abundance (Habitat II, Table A1-10). Total abundance, 102,025/m^2, representing 41 taxa, was nearly double the total abundance in other areas of Spectacle Island. Secondary dominants were similar to other areas of Spectacle Island with one exception. The opportunistic polychaete *Polydora cornuta* (22% of the total abundance) was joined by *Streblospio benedicti* (18%) and *Aricidea catherinae* (5%). Nephtyid polychaetes, an important food for lobster and demersal fish such as winter flounder, were collected in moderate numbers.

Lobster

A lobster transect survey was undertaken to quantify lobster use of the area and evaluate the substrate for use or potential use by early benthic phase lobsters, considered to be a vulnerable stage for this species because of limited habitat availability (Wahle and Steneck 1991). CA/T transects 1 (southernmost), 2, 3, 4 and 5 (northernmost) were located along the east side of Spectacle Island (Cortell 1990b); transects 3 and 4 were within the area proposed for the CAD. Free-living lobsters were most abundant off the north shore of Spectacle Island (Transect 5 yielded 0.0027/ft^2; Transect 6 yielded 0.0035/ft^2); Transect 3 yielded the third highest abundance (0.0022/ft^2). Abundances along Transects 1, 2 and 4 were low (0.0003-0.0004/ft^2). These average abundances, however, do not account for the fact that lobsters were concentrated towards the deeper end of all transects except Transect 3. Lobster pot markers were present in the proposed site during all three surveys in 1990. Pot markers tended to be most heavily concentrated off the

northern shoreline of the island and farther east of the island in Sculpin Ledge Channel (Cortell 1990a).

During a lobster monitoring program run from early May to early July, 1992 in the Harbor, Cortell (1992) reported that an average of five lobsters (average catch per 3-day haul, all size classes) per trap were collected at a station just to the north of Spectacle Island, the southern side of the ship channel. This catch was typical of several other stations in this study. Other trawl sampling indicated that abundances were generally lower at a site (closest to Spectacle Island) just north of the Ship Channel in President Roads, compared with four other stations in the channel area. At the time, lobstermen fished this area along the edge of the channel between Spectacle and Long Island.

No early benthic phase (EBP) lobsters were found in samples collected along lobster transects. The preferred cobble substrate (Wahle and Steneck 1991) was common only along the nearshore portions of Transects 1 and 5. Mussel beds may also enhance substrate suitability (Wahle and Steneck 1991). Mussel beds occurred along the nearshore portions of Transects 2, 4 and 5. It was speculated that the anoxic sediments underlying these mussels would preclude use by EBP lobsters (Cortell 1990b). The borings collected offshore of these transects indicated that sediments were fine-grained, unsuitable for EBP lobsters (Cortell 1990b).

A lobster survey in October 1994 collected a total 0.2 lobsters per trap-day, all under the legal size limit (Table A1-7). The CPUE at this site was among the lowest of the stations sampled in Boston Harbor. No commercial lobster pots were observed in the area during the survey. Conversations with local lobstermen at the time of the survey indicated that they no longer fish in the area because of a lack of lobsters (NAI 1995b). Trawl sampling in October 1994 captured an average of 6.7 lobsters (based on 5 minute tow results standardized to a 20 minute tow), which was similar to that collected in the Chelsea River and Subaqueous E, and an order of magnitude lower than the lobster catch at Boston Lightship (Table A1-4).

Finfish

A trawl survey of demersal fish in October 1994 collected a average of 21.3 finfish per 20 minute trawl, one of the lowest catches in the Boston Harbor area (Table A1-4). Winter flounder was the predominant species (9.3 CPUE), followed by skate sp., both of which are typically demersal. Rainbow smelt and Atlantic silverside, generally pelagic species, were also collected.

Based on the on-going development of the artificial reef design, as required by the Individual Permit—Landfill Closure and Maintenance at Spectacle Island for CA/T (ACOE no. 199202207; 2/16/93), target fish species in the Spectacle Island area include forage species such as Atlantic menhaden, Atlantic herring and rainbow smelt, and predator species such as winter flounder, striped bass, bluefish, pollock, Atlantic cod, tautog and cunner. The northeastern half of Sculpin Ledge Channel is the recommended location for the proposed terrace reef (NAI 1993).

WETLAND RESOURCES

The Spectacle Island CAD location is considered Land Under the Ocean under the Massachusetts Wetland Protection Act (310 CMR 10.00) and Tidal Waters under the Federal Clean Water Act (40 CFR 230). As Land Under the Ocean, the site is considered to be significant to the protection of marine fisheries, protection of land containing shellfish, storm damage prevention, flood control and protection of wildlife habitat. This area has been demonstrated to provide habitat for free-living, but not early benthic phase, lobsters and juvenile rock crabs (Cortell 1990b). Active use of the area by finfish has not been examined but is likely to occur to some degree for feeding (although benthic fauna is sparse) and passage. Waterfowl may feed in this area. Portions of the nearshore area of Spectacle Island are classified as Land Containing Shellfish (mussels). The proposed subtidal location of Spectacle Island CAD intercepts the tidal currents from the channels, reducing their intensity. This increases deposition offshore from the shellfish beds, protecting them from excess siltation. Shoreline erosion is reduced by the reduction in currents. Storm energy is dissipated by the shallow subtidal expanse east of the

island. Because this is an open water area, however, the shore east of Spectacle Island provides little flood control.

Classified as Tidal Waters under federal regulations, Spectacle Island CAD was evaluated for its ability to provide the functions of sediment/toxicant retention, nutrient retention/transformation, recreation and uniqueness/heritage. Sediment sampling at this site revealed only low levels of chemicals and low-to-moderate levels of fine-grained sediments. However, reduced currents provide Spectacle Island CAD with greater potential for performing the functions of sediment/toxicant retention and nutrient retention/transformation than the adjacent channel areas. It is likely that recreational boaters with shallow-draft vessels cross this area. Human use of the island will increase once park development is underway.

WILDLIFE

Waterfowl, including great cormorant (*Phalacrocorax carbo*), herring gull (*Larus argentatus*), white winged scoter (*Melanitta deglandi*), common goldeneye (*Bucephala clangula*), bufflehead (*Bucephala albeola*), mallard (*Anas platyrhynchos*), black duck (*Anas rubripes*), merganser (*Mergus* spp.) and scaup (*Aythya* spp.) have been observed in the vicinity of Spectacle Island (Cortell 1990a). Each of these species feed on fish and invertebrates (Martin et al. 1951; Whitlatch 1982; DeGraaf and Rudis 1986) that occur in the area proposed for Spectacle Island CAD.

THREATENED AND ENDANGERED SPECIES

No federally or state-listed threatened or endangered species are identified or expected to occur within the immediate vicinity of Spectacle Island CAD. Common terns have nested on a dilapidated pier on the northwestern end of Long Island, approximately 0.6 miles away, across Sculpin Ledge Channel. All marine mammals are protected under the Federal Marine Mammals Protection Act. Harbor seals (*Phoca vitulina*), harbor porpoises (*Phocena phocena*) and grampuses (*Grampus griseus*) occur occasionally in the harbor. None of these species are listed

as threatened or endangered. There are no natural occurrences of exposed ledge that would be suitable as seal haul-outs in the vicinity of Spectacle Island CAD.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources at the Spectacle Island CAD site.

SOCIO-ECONOMIC/LAND USE

Activities at the subtidal area east of Spectacle Island would be visible from Spectacle Island, Long Island, and Deer Island as well as from vessels using Sculpin Ledge Channel and President Roads. Currently public access to Spectacle Island and Long Island is limited although park development on Spectacle Island is expected to begin in 1995. Vessels using President Roads are predominated by commercial ships, whereas Sculpin Ledge Channel is actively used by fishing vessels and pleasure boats.

This location is currently used only by fishermen and recreational boaters. The site is less than 1000 ft. from the proposed dike which the Massachusetts Highway Department intends to construct as part of its closure of the abandoned landfill at Spectacle Island.

2.4.1.3 Meisburger Sites 2 and 7

These sites are depicted on Figures A1-16 and A1-17.

SEDIMENT CHARACTERISTICS

The sand and gravel deposits that characterize these sites were first described by Meisburger (1976) from sub-bottom data. The sites are in approximately 100 ft of water (80-110 range). Sand and gravel form much of these irregularly shaped deposits and a layer of medium sand (up to three feet thick) may cover some of these areas locally. Because these sites are within the nearfield study area of the proposed MWRA outfall, they have received recent detailed inspection (Shea et al. 1991, Butman et al. 1992 and Blake et al. 1993). A 4 x 5 nautical mile area around the proposed outfall was characterized in detail by Butman et al., (1992) and the most common sediment type in the area surveyed was coarse sand and gravel (42%). These deposits lay between gravel and boulder covered drumlins which comprised 23% of the study area. Fine-grain sediments (6%) and a highly variable or patchy distribution of mud, sand and gravel (29%) made up the remainder of the cover. The areas described by Meisburger (1976) are predominately covered with sand and gravel although the boulder areas border some of the deposits in these areas. Results of other studies in this area (Blake et al. 1993; Shea et al. 1991) are generally consistent with the above findings although most of their data were collected from REMOTS images from representative data. Studies from this area point out that bottom sediments indicate higher energy areas in some locations while other areas appear to be depositional (silt, clay sediments), with sand underneath.

WATER QUALITY AND CIRCULATION

Again, because of the proximity of these site locations relative to the MWRA offshore outfall site, recent studies have focussed on this area and long-term monitoring of water quality and hydrography is planned (MWRA 1991). Although a 3-D hydrodynamic model of Massachusetts/Cape Cod Bays is still in development, intensive physical oceanographic surveys were conducted between April 1990 and June 1991 (Butman et al. 1992). Some of this long-term monitoring is located immediately adjacent to the MWRA outfall at Buoy "B". While the report should be referenced for the details of initial findings, some relevant findings to this assessment include:

- There is an absence of well-defined current in this area, but water and particle transport takes place by a variety of actions, including tides, winds and river flow;

- Maximum tidal currents 1.0 m off bottom are in the range of 6-8 cm/s in this area (the mean is in the 2-4 cm/s range), compared with much faster currents (18-20+ cm/s) at the mouth of Boston Harbor and somewhat slower currents (4-6 cm/s) at the MBDS. Mean water currents at 5.0 m at this site are typically in the 4-7 cm/s range;

- Maximum re-suspension of fine-grain materials coincides with storm events that show a 2-4 fold increase in suspended material in the water column compared to background (i.e. non-storm periods) in the winter.

The waters in this area have been classified as Class SA. This classification protects the saline waters for the propagation of marine life, primary and secondary contact recreation and shellfish harvesting without depuration in approved areas.

AQUATIC RESOURCES

Benthic Infauna

Recent studies (Blake et al. 1993) have involved benthic sampling adjacent to Meisburger 2 in areas shown by Butman et al. (1992) to have a patchy distribution of mud, sand and gravel or a mud or fine sand cover. The station nearest Meisburger 2 in Blake's study had 63% sand and gravel. Infaunal benthic densities averaged 83,325 per m^2 with the number of species totalling 67 (samples were collected through a 0.3 mm sieve). The community was composed mainly of a polychaete assemblage dominated by *Spio limicola*, *Polydora socialis*, and *Mediomastus californiensis*.

Sediment profile camera sampling at both Meisburger 2 and Meisburger 7 in 1994 indicated several benthic communities were present. Approximately half of the stations at each site contained primarily rock sediments intermixed with sand and gravel, indicating a high-energy, erosional bottom habitat (NAI and Diaz 1995). Epifauna were observed colonizing the rocky substrate. No RPD layer was observed because sampling gear was not able to penetrate the substrate. Benthic fauna in this habitat (V) at Meisburger 2 had moderately high abundance (11,075/m^2) representing 55 taxa from one 0.04/m^2 sample (Habitat V, Table A1-11). The most abundant species was the tube-dwelling amphipod *Unciola inermis* (11% of the total abundance), followed by spionid polychaetes *Polydora quadrilobata* (11%), and *Prionospio steenstrupi* (Table A1-11). This community at Meisburger 7 had one of the lower abundances at offshore stations (4962.5/m^2), representing 61 taxa from 2 0.04-m^2 samples (Habitat V, Table A1-10). Polychaetes were the most numerous organisms. Dominants included the surface dwelling spionid *Polydora socialis*, deep dwelling maldanid *Euclymene collaris*, and lumbrinerid *Ninoe nigripes*. The presence of deep dwelling organisms is an indication of a healthy benthic community.

Approximately one third of the remaining areas at Meisburger 2 had sand substrate, in some cases with overlying silt (NAI and Diaz 1995). The RPD layer, when observed, ranged from 1.2-2.0 cm, indicating sediments were relatively well oxygenated. A moderate number of fauna tubes were observed at the sediment surface and on rocks. Infaunal burrows were observed in the cases where subsurface observations were possible. Benthic samples revealed a diverse community (150 taxa in the 6 0.04-m^2 samples) with moderately high abundance (9,534/m^2, Habitat VII, Table A1-11). Polychaetes predominated, including spionid *Polydora quadrilobata* (10% of the total abundance), and *Polydora socialis* (9%) and cirratulid *Aphelochaeta marioni* (9%). Many surface-dwelling crustaceans, including cumaceans, isopods, and amphipods, occurred in low numbers. Epifauna (taxa such as Hydrozoa, Bryozoa, and Ascidacea) were present. The remaining stations at Meisburger 2 had heterogenous sediments, mainly sand and gravel with some silt and rock. The depth to the RPD layer, when observable, ranged from 0.5-1.5 cm below the sediment surface. The total number of individuals, 17,925/m^2, was the highest of the offshore stations that were sampled (Habitat VIII, Table A1-11). Polychaetes such as spionid *Polydora quadrilobata* (23% of the total abundance), sabellid *Euchone elegans* (14%), and cirratulid *Aphelochaeta marioni* (11%), were the most abundant organisms. A total of 88 taxa were collected in the 2 0.04-m^2 samples.

Most of the remaining stations at Meisburger 7 had a gravel substrate mixed with sand and/or rocks (NAI and Diaz 1995). The RPD layer, when observed, was within 1 cm of the sediment surface, with one exception (8.0 cm, station 23). Epifauna tubes were observed on the sediment surface. Observations of the subsurface area in many cases could not be made because the substrate was impenetrable. Silt sediments, in some cases with a layer of fine sand, were observed in a small area on the western edge of Meisburger 7. This area had evidence of well oxygenated sediments, as indicated by an RPD layer generally at a depth of at least 5 cm. There was evidence of bioturbation including oxic voids and burrows.

Lobster

A lobster survey using experimental traps was conducted in October 1994. Meisburger 2 had the highest CPUE of all stations visited in Boston Harbor, a total of 6.4 per trip-day, of which 0.1 met the legal size limit (Table A1-7). Meisburger 7 had second highest lobster catch of all sites, 5.1 per trip-day, of which 0.1 were of legal size. Lobsters were also collected in gill nets set at the Meisburger sites in October 1994 (Table A1-6). An average of 5 lobsters per 24 hour set was collected at Meisburger 2, and 4.3 lobsters at Meisburger 7. Lobsters were rarely collected in gill net collections at other sites in Boston Harbor. A review of the Massachusetts Division of Marine Fisheries data on the location of the lobster fishery fishing effort in 1991, 1992 and 1993 showed fishing traps in the vicinity of Meisburger 7, but no traps located near Meisburger 2 (NAI 1995b).

From a commercial fisheries perspective, these sites are within the area of greatest territorial harvest for the coastal lobster fishery (unpublished data, MADMF 1991). For example, Area #4 (which extends from Lynn to Cohasset) accounted for 41.1% of the 11,000,500 pounds caught (on coastal licenses) in Massachusetts territorial waters. Site-specific catch data for these disposal sites were not available.

Finfish

Trawl data provided by the MADMF (1991-92 Resource Assessment/Surveys, unpublished data) for a station two nautical miles west of the new MWRA outfall indicated that three commercial finfish species (winter flounder, Atlantic cod and yellowtail) made up 40-60% (collectively) of the total catch (Table A1-12). The total catch (all fish) from two spring (May '91 and '92) collections were 655 (20 min. tow) and 685 (13 min. tow); a total of 17 and 60 lobsters were also collected from these same tows. Rock and Jonah crabs were found in small numbers. Total abundances of fish and lobster at this site were average to above average compared with 10 sampling events (in May and August 1991-92) distributed offshore from Nantasket Beach to the MBDS.

A gill net survey at Meisburger Sites 2 and 7 was conducted in October 1994. Gill net CPUE (fish only, per 24-hour set) averaged 12.3 at Meisburger 2 and 17.4 at Meisburger 7, moderate among the Boston Harbor stations where samples were collected (Table A1-6). Mackerel was the most abundant species collected. Longhorn sculpin, cunner, and Atlantic cod, all typically demersal species, were secondary dominants.

WETLAND RESOURCES

The Meisburger sites exist beyond the geographical and depth jurisdiction of the Massachusetts Wetlands Protection Act and Regulations (MGL c.131, s.40, and 310 CMR 10.00). These sites fall within the federal designation of tidal waters since they fall within the territorial sea of Boston Harbor, and the associated 3 mile limit of jurisdiction required for the discharge of dredged or fill material under Section 404 of the Clean Water Act.

WILDLIFE

Approximately 35 species of marine mammals, 5 species of marine turtles and 40 species of seabirds occur within the Gulf of Maine. Aerial surveys were conducted for the ACOE

to assess the use of the Massachusetts Bay Disposal Site (MBDS) by marine mammals, reptiles and seabirds (MBO 1987). The dominant species observed within the MBDS locale are typical of the offshore waters of Massachusetts (Meisburger and Boston Lightship sites).

Seabirds observed include northern fulmar (*Fulmanus glacialis*), shearwater (*Puffinus* sp.), storm petrels (Hydrobatrae), northern gaument (*Sila bacsaus*), Pomarine jaeger (*Steriovarius pomarinum*), gulls (Larinae) and Alcids (Alcidae). Dominant nonendangered mammals include minke whale (*Belasnoptera acutorostrata*), white-sided dolphin (*Lagenorhynchus acutus*), and harbor porpoise (*Phocena phocena*). Although five species of turtles potentially could occur on Massachusetts Bay, only the leatherback turtle (*Dermochelys coriacea*) is typical in the area.

THREATENED AND ENDANGERED SPECIES

The following threatened and endangered aquatic species can occur in the Western North Atlantic including parts of Massachusetts Bay (U.S. Department of the Interior 1991):

Cetaceans

right whale (*Eubalaena gracilis*) (Endangered)
humpback whale (*Megaptera novaeangliae*) (Endangered)
finback whale (*Balaenoptera physalus*) (Endangered)
sei whale (*B. borealis*) (Endangered)
sperm whale (*Physeter macrocephalus*) (Endangered)
blue whale (*B. musculus*) (Endangered)

Turtles

Kemp's ridley (*Lepidochelys kempi*) (Endangered)
leatherback (*Dermochaelys coreacea*) (Endangered)
hawksbill (*Eretmochelys imbricata*) (Endangered)

loggerhead (*Caretta coretta*) (Threatened)
green (*Chelonia mydas*) (Threatened)

Fish

shortnose sturgeon (*Acipenser brevirostrum*) (Endangered)

Studies have shown that the majority of local threatened and endangered whale sightings have been concentrated near the tip of Cape Cod in the northern and central areas of the Great South channel and north of Cape Cod along Stellwagen Bank and Jeffrey's Ledge (ADL 1992). The sightings offshore from Boston Harbor are typically concentrated eastward of the MBDS, within the newly designated Stellwagen Bank National Marine Sanctuary. The Meisburger sites are approximately half way between Boston Harbor and the MBDS and are not a reported area of concentration for these species. Whale watch cruises out of Boston Harbor do not attend these areas.

Of the five threatened or endangered turtles that could occur in this area, the leatherback, Kemp's ridley and the Loggerhead are the most regularly observed in Massachusetts and Cape Cod Bays. Of these species, the leatherback is the most frequently encountered, with the western North Atlantic estimated to support 16,000 individuals (Lazell 1980); however, it is primarily an oceanic species. The loggerhead may show the most common inshore occurrence, with 7,700 individuals estimated to be in north and middle Atlantic coastal water (CETAP 1982). The Kemp's ridley turtle would be the most rare, with the Atlantic population estimated to be less than 500 individuals (Carr and Mortimer 1980). There is nothing unique about the Meisburger 2 and 7 sites that would attract these species nor are we aware of any specific sightings for this area.

The shortnose sturgeon inhabits estuarine and freshwater areas along the eastern coast of the U.S. and Canada and would not be an inhabitant of these open water alternative disposal sites.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources on the Meisburger 2 and 7 sites.

SOCIO-ECONOMIC/LAND USE

The Meisburger 2 and 7 sites are located in an area used for recreational boating and for commercial fishing. The sites are easily reached by barge during fair weather conditions. The sites are within one mile of the Massachusetts Water Resources Authority's Ocean Outfall, currently scheduled for completion in 1995.

2.4.2 Environmental Consequences of the use of In-Channel and Borrow Pit Sites for Dredged Material Disposal

In-Channel Sites

The areas of these channels that would be improved, as defined in Section 3.3, would be overdredged (to -48 to -70 ft in the Mystic River and Inner Confluence and -49 to -65 ft in the Chelsea River) to accommodate silt disposal. Disposal areas would be created in cells (Section 4.0), generally about 200 ft by 500 ft (2.3 acres) in size, for a total cell footprint of about 116 acres (Mystic River = 56 acres; Inner Confluence = 21 acres; Chelsea River = 40 acres). As cells are filled, a sand and rock cap would be placed over the disposed dredged materials.

Direct Impacts

Because all disposal activities would be limited to the footprint of the improvement dredging, there would be no additional direct habitat losses, either permanent or temporary, as a result of the disposal. Closure of the disposal trenches would alter habitat conditions, however.

A cap would be placed over the disposed silt to serve several purposes. Its primary purpose would be to isolate the dredged silts from the harbor, isolating them from further biotic activity or exposure. It has been demonstrated that a cap of 1.5 ft prevents the flux of contaminants from sediments into the overlying water (Fredette et al. 1992). The proposed 3-foot sand cap, armored where necessary with rock, would protect the silt from resuspension and downstream transport caused by propeller wash of cargo ships and tugs passing through the channels. The cap has been designed to be sufficient to prevent future maintenance operations from disturbing it and releasing the covered silts; the rock on the surface provides a substrate that would be easily identifiable by a dredge operator (either by "feel" or visually when the bucket was opened into the barge) in the future.

The cap would temporarily be virtually free of chemical contaminants, an improvement over the conditions currently present in the channels. Cap material would be highly unlikely to adsorb contaminants - characteristically, mineral sediments do not. However, the cap would probably not change the rate at which contaminated silt from other sources accumulated in the channels. On average, the Chelsea Channel has been estimated to accumulate sediments at a rate of about 1 inch per year. Sedimentation rates are much higher in the Mystic Channel; they have been estimated to average 3 inches per year. It is unlikely that sedimentation is evenly distributed throughout these channels, however.

Ships turning into the Mystic and Chelsea Channels from the Inner Confluence operate at higher speeds than in the rest of the channel and thereby generate bottom currents that are capable of resuspending silt on a regular basis. Therefore, this area may be kept swept clean of silt for an extended period of time. Propeller wash generated by vessels and tugs passing through the channels may be playing a major role in redistributing silts throughout the harbor. Bottom currents caused by ships travelling even at low speeds resuspend a sediment layer up to 0.2 m thick (OCC 1995). Most (95%) of this material is immediately redeposited, but about 5% is available for transport. Localized short-term turbidity plumes are evident behind vessels traversing the channels. The small-bodied, surface dwelling invertebrates that inhabit channel sediments are probably also resuspended when this occurs. This action creates a continually disturbed benthic environment in the channels. The cap material would not be resuspendable by these currents. Therefore, the cap could reduce the rate of resuspension and resedimentation from propeller wash.

Until the cap has been silted over, it could provide an improved habitat for survival of winter flounder eggs (and other demersal species), both by providing a more stable structure to which to attach and by creating an environment that is less stressed by siltation (resulting in reduced "smothering"). Juvenile winter flounder would use the sandy areas because it provides the granular sediments that this species burrows into. Flounder would not use the areas armored by rock.

Benthic fauna capable of inhabiting the are armored by rock would likely differ from the infauna present in the fine-grained sediments present now in the channels. The rock would provide suitable substrate for attachment of fouling organisms, such as are now present on the deeper portions of bulkheads and pilings around the harbor. These species could provide suitable food for browsing fish and lobsters. Interstitial spaces in the rock would fill with sand or silt and thus provide a more diverse habitat. This would tend to increase the species diversity and enhance the habitat.

Indirect Impacts - Water Quality Effects

Modelling done to evaluate impacts to water quality during the disposal operations (short-term impacts) is detailed in Appendix F. Conditions one hour after a single drop (after steady state was reached) were used to predict the mixing zone. In the case of these in-channel sites, the effects of nearby dredging were added to the disposal event. Conditions representing repetitive disposal events were modelled to describe more typical conditions.

The distribution of suspended sediments and PCBs released into the water column was modelled following an instantaneous release of silt from a barge in the Mystic River, the Inner Confluence and the Chelsea River to determine appropriate mixing zones for each area. Preliminary results indicated that disposal around high tide would prevent excessive buildup of TSS or contaminants. Therefore, the mixing zone analysis assumed that this restriction would be adhered to. In all three in-channel disposal locations, the mixing zone needed to meet the proposed TSS limit (Appendix F) would be larger than that for PCBs, assuming that all Mystic River sediments would be disposed in the Mystic River channel. In each case, the mixing zone

would be a narrow, elongated area running along the axis of the channel and would not extend all the way across the width of the channel. The dimensions of the necessary mixing zones are listed on Table A1-13.

Modelling of repetitive disposal events is more indicative of the level to which constituents would accumulate in an area over the course of the project. It was predicted that disposal would cause some buildup of suspended sediments (reaching equilibrium within a few days) that would dissipate with distance from the disposal site, partially due to dilution with tidal waters and partially due to the natural tendency for the particles to settle out of the water column. Highest concentrations of suspended sediments (measured as total suspended solids or TSS) would occur in the immediate vicinity of the disposal site (Table A1-14). Background concentrations in the inner harbor were observed to be less than 5 mg/L prior to dredging the Third Harbor Tunnel in 1992 (EA 1992). Dredging the Third Harbor Tunnel resulted in concentrations of total suspended solids averaging about 21 mg/L 500 ft downstream of the dredge, with tidal stage having little influence on the concentration.

Elutriate testing indicated that metals such as copper and mercury could dissociate from the sediments and dissolve during disposal. Repeated discharges of dredged material would have the effect of allowing these parameters to build up in the water column (reaching equilibrium within about two months), particularly in the immediate vicinity of the disposal site. Dilution and transport by tidal action would be the main factor causing dissipation of these parameters. Most metals also have a high affinity for fine-grained sediments (e.g. silt); they would gradually be reabsorbed to the particles and tend to drop out of the system with the silt. The highest concentrations predicted for the dissolved metals (3.2 ng/L for mercury; 5.7 ng/L for copper; Table A1-14) are well below the chronic water quality criteria (25 ng/L for mercury; 2900 ng/L for copper) established by the USEPA (1986 UPDATE?).

Elutriate tests indicated that PCBs were likely to be released from sediments dropped from the barge. Mechanisms similar to those described for the metals would control dispersion of PCBs from the disposal site. Reparticularization is considered to be an important factor in partitioning PCBs between dissolved and particulate phases. PCB concentrations varied in the Harbor; a portion of the sediments proposed for dredging from the Mystic River had substantially

higher bulk concentrations than the remaining sediments. Therefore, water quality models were run using two different elutriate values. Even under worst case conditions (i.e., Mystic River sediments), the PCB concentrations, including ambient, would be about 60% of the chronic water quality standards.

Because of their high carcinogenicity, the potential for release of PAHs, represented by naphthalene, was examined. Although PAHs were not measured in elutriate testing, concentrations of the 16 individual priority pollutant PAHs were estimated based on organic-water kinetics (see Appendix IV). Naphthalene was the most soluble of the 16 compounds in the sediments. Applying these values to the water quality modelling, it was predicted that PAHs would exhibit little accumulation in the water column. Naphthalene was predicted to occur at concentrations nearly five orders of magnitude lower than the LOEL (lowest observed effects level) water quality criterion of 2350 ppb (no chronic criterion has been established).

Indirect Impacts - Site Stability

Vessel traffic, particularly through the turns into the Mystic and Chelsea Rivers, resuspends sediments in a triangular zone of influence reaching to 40 m wide 170 m astern of an LNG tanker (the worst case). Vertically, the ship-induced velocities also dissipate with depth below the center of the propeller. However, none of the cells are projected to be deeper than the zone of influence. While the propeller wash would resuspend approximately a 0.2 m layer of sediments in this area, about 95% of this material resettles rapidly. A ship traversing the 800 m long turning area in the Inner Confluence would cause a net increase in suspended sediments of about 423 cy. Other cargo vessels would have slightly less impact on the substrate, but would also resuspend sediments. Ship traffic levels in Boston Harbor average about two cargo vessels per day. The largest vessels, LNG tankers, enter the Mystic River at a rate of 1 to 2 per month.

This effect is of concern for the use of the in-channel disposal sites both during the filling phase and following closure of the cells. During the filling phase (a period estimated to last up to 14 days) the disposed sediments could be resuspended from within any cell within the zone of influence of a passing vessel. The quantity of material resuspendable would increase as

the cell was filled. While this effect would not differ from what normally occurs, it would be counterproductive for the dredging and disposal operations. Ideally, this effect could be minimized by careful scheduling of disposal to use the cells in the most vulnerable areas during periods when LNG tankers are not scheduled, and to restrict vessels from passing within 20 m of an open cell whenever safe navigational practices allow this.

Following closure of each cell, the cap could be susceptible to the erosional forces of the vessel traffic as well. In this case, the concern would focus on maintaining the integrity of the cap to prevent re-exposure of the disposed silts. Clearly it would be infeasible to restrict vessel traffic. Therefore, the emphasis would have to be placed on the strengthening of the cap itself. The ship simulation study (Appendix D in the DEIR/S) and geotechnical surveys in the channels were examined to determine areas likely to be scoured on a regular basis. These were identified as the areas most vulnerable to propeller wash effects. It is recommended that the caps on the cells in these areas be armored with rock.

Long-term monitoring of dredged material capping in Long Island Sound (Fredette et al. 1992) has indicated that no upward migration of contaminants through the cap would occur. Fredette et al. found that after 11 years, the chemical signature of dredged silt and an unengineered cap in Long Island Sound remained distinct. Migration of contaminants into the cap was limited to about 10 cm. In this boundary layer, metals concentrations were $\leq$ 5% of the dredged material and selected PAH concentrations were 0 - 10% of underlying sediments. The proposed rock layer on the surface of the cap at the in-channel disposal sites would armor and prevent resuspension of the underlying sand by propeller wash. Initially, there would be no fine sediments present on the surface, so turbidity caused by propeller wash could be reduced. It is likely that silts will eventually be transported into the channels from other sources, however, potentially negating this effect eventually.

Indirect Impacts - Downstream Resources

Downstream biological resources of concern include anadromous fish species (alewife, blueback herring and rainbow smelt) on their spawning runs up the Mystic River, spawning winter

flounder (and their demersal eggs), and small intertidal flats (potential soft-shell clam habitat) in the Chelsea River. Geographical areas of concern are shown on Figure A1-22.

Downstream areas are expected to experience minimal impacts for several reasons. Dredging and disposal activities in the Mystic River and the Inner Confluence will be avoided during the period from February 15 to June 30 to prevent impacts to anadromous fish passage. Restriction of activities during this time period would also help protect winter flounder spawning areas. The primary concern for anadromous fish would be contact with elevated concentrations of suspended sediments and exposure to elevated levels of dissolved contaminants. A plume of elevated suspended sediments could deter the fish from entering the Mystic River prior to spawning or juveniles swimming downstream in the late summer and fall if the plume spread across the entire width of the channel, although Klauda et al. (1991) reported that the most susceptible lifestages (eggs and larvae) of alewife and blueback herring could survive exposure to suspended solids in concentrations as high as 500 - 1000 mg/L. In this unlikely event, the fish would probably congregate in a low current area until the changing tide reconfigured the plume, allowing passage. Because the concentrations of dissolved constituents that are expected to occur during the disposal would be below chronic water quality criteria, they would not impact anadromous fish or other pelagic organisms.

Because winter flounder are demersal in all except larval lifestages, contact with the substrate and exposure to increased sedimentation would be of greatest concern. Sedimentation of material dispersed into the water column during each disposal event would likely be most concentrated in an area about 240 ft (80m) north to 240 ft (80m) south of each cell for the period that the cell was being filled (about one to two weeks per cell). Each disposal event could contribute a layer of sediments about 1.4 cm (0.5 in) thick in this area, but build-up would be unlikely because this layer would have a high water content and be easily resuspended and transported. Mortality of winter flounder eggs subjected to sedimentation from this source would likely increase slightly over existing conditions if ship passage does not resuspend this silt. Because channel sediments represent the majority (78%) of the silt volume to be disposed, and, except for the Reserved Channel, dredged material would be disposed in the tributary from which it was dredged, this sedimentation would be unlikely to increase concentrations of contaminants.

Intertidal flats along the Chelsea River would be unlikely to experience detectable sedimentation. Sedimentation is most likely to occur parallel to the axis of the channel rather than towards the shoreline.

There are a number of water intakes along the waterfront that are also of concern. There are six lobster pounds and the New England Aquarium that draw water from the harbor to support live animals. These intakes are generally located outside the zone of highest concentration of TSS or contaminants anticipated for this disposal activity.

Indirect Impacts - Biological Exposure Potential

Water Column Exposure

None of the parameters that were suspected to be problematic in terms of water quality (based on elutriate values or ambient conditions) are anticipated to concentrate to levels exceeding the chronic water quality criteria. Highest concentrations would be restricted to a limited portion of the harbor. It is assumed, therefore, that exposure of biota to these levels would have no discernible effect. Water column exposure would be limited to the 1.5-year disposal period.

Substrate Exposure

Because of the relatively small size of each cell (8,000 to 42,000 cy silt capacity), dredged materials would be exposed only for a period of about 5 to 14 days, on average, prior to capping. This would be insufficient time to allow recruitment of a substantial benthic population and subsequent feeding by demersal fish. It is unlikely that finfish would linger in the disposal cells because of elevated turbidity, general activity and lack of food resources. Even if they did, exposure for one to two weeks would be unlikely to cause adverse effects for several reasons. Bioaccumulation is typically assumed to require about one month of exposure to reach equilibrium; most uptake would have to occur through dermal contact rather than ingestion. Each cell has a footprint of 2.3 acres or less, less than 2% of the available substrate in the Mystic River between the Tobin Bridge and the Amelia Earhart dam. And, finally, the chemical profile of the disposed sediments would not be substantially different from the adjacent substrate.

The small downstream areas subject to sedimentation may have a higher potential for exposing substrate-oriented organisms to contaminants. Based on the relative volumes of dredged material from the berths (22%) and the channels (78%), it is likely that downstream deposits would reflect the chemistry of the channels rather than the berths. Because the only downstream areas that are predicted to experience sedimentation because of disposal are in the channels, this action is unlikely to increase exposure to organisms substantially over what they experience now.

Other Issues

No federally or state-listed threatened or endangered species have been identified to occur in the channel and tributaries, so adverse impacts are not expected.

This disposal alternative would have no effect upon any structure of historic or archeological significance as defined by MHC or the National Historic Preservation Act of 1966, as amended.

BORROW PITS

There are three sites (Spectacle Island, Meisburger 2 and Meisburger 7) that could be used as borrow pits - sites where existing sediments would be dredged and removed to prepare the site for use. Of the three sites identified for this type of development, the two Meisburger sites have deposits of sediments that would be suitable for beneficial uses (beach nourishment or construction fill), while sediments at Spectacle Island would likely not. The Meisburger sites could be developed either as cells or in one large compartment. It is unlikely that the existing sediments near Spectacle Island would provide sufficient geotechnical strength to support construction of small cells because borrow pit construction would not penetrate into parent material at this site. The resulting cells or pit would be filled with silts from the BHNIP and capped with sediments that had been reserved during the initial site preparation or pit creation.

SPECTACLE ISLAND CAD

Spectacle Island CAD is located east of the island on a shallow tidal flat. Water depths range from -8 to -12 ft MLW. Substrate is primarily fine sand and silt. Disposal of silts from the BHNIP would require dredging one large containment cell over a footprint of 45 acres, to a bottom depth of 23 ft below the existing substrate. Silt would be filled to a depth three feet deeper than the surrounding substrate. Silt would be capped with sediment retained from pit dredging to a final depth equivalent to adjacent substrate.

Direct Impacts

There would be no permanent loss or alteration of habitat associated with the use of the Spectacle Island CAD. Dredging the cell would not impact areas outside the footprint, although the material retained for the cap would likely be stored on substrate adjacent to the cell. This would cause a loss of benthic productivity for the duration of the dredging project, about 1.5 years, in addition to the time needed for the storage area to recover, probably an additional year or more. Any remaining material dredged from the cell would be disposed at the MBDS. Benthic fauna would be unable to colonize the cell for the duration of the disposal activities (about 1.5 years). Because the benthic community presently at the site (and throughout the outer harbor) is dominated by the pioneering amphipod *Ampelisca*, it is likely that the cap would be at least partially recolonized within a year of closure of each cell. Tube-building habits of this organism plays a substantial role in stabilizing the sediments in the outer harbor.

If it becomes necessary to armor the self-cap with rock, the character of the benthic community would change dramatically. *Ampelisca* does not occur on hard bottoms. It is possible that the rock bottom, and interstitial areas where fine-grained sediments accumulated, could be as productive as the *Ampelisca* community. Rock could support macroalgae and a diverse macroinvertebrate community; interstitial areas could support many of the infaunal species observed in the area in fall 1994. Such a substrate could complement the Central Artery's artificial reef near the site in Sculpin Ledge Channel.

Indirect Impacts - Water Quality Effects

The mixing zone required for the disposal of BHNIP sediments at the Spectacle Island CAD would be best defined by the area necessary to dilute total suspended solids to <50 mg/L. Concentrations of TSS at this location would not be influenced by BHNIP dredging activities in the harbor. Disposal at or around high tide would optimize the dissipation of vagrant sediments. Under these conditions, the mixing zone would require an area of about 18.0 acres (240m by 270m) and would be oriented towards Sculpin Ledge Channel (Appendix IV).

Pollutant transport modelling indicated there was little potential for short-term water quality impacts caused by the disposal of BHNIP silts in the Spectacle Island CAD (Table A1-15).

Indirect Impacts - Site Stability

Although its location is removed from the shipping channels where tidal currents peak in the Outer Harbor, the subtidal flat east of Spectacle Island could experience spring tidal flows as high as 0.7 to 1.0 ft/sec (21-31 cm/sec). While these flows are high enough to resuspend unconsolidated silts, existing *Ampelisca* beds probably stabilize these silts.

The shallow conditions east of Spectacle Island are generally avoided by most vessels except small recreational boats. Therefore it is unlikely that this area would be exposed to propeller wash that could resuspend sediments. The frequency of use by recreational boaters would likely increase, however, after the artificial reef developed as mitigation for the Central Artery project has been deployed. The anticipated date for this deployment is the summer of 1996, less than a year before dredging for the BHNIP is expected to begin.

The site for the Spectacle Island CAD is directly exposed to the Atlantic Ocean through the mouth of Boston Harbor. The shallow conditions present at this site would induce wave cresting and breaking. Wave-generated bottom-currents from a one-year storm could reach 5.8 ft/sec (>175 cm/sec), far in excess of the velocity needed to resuspend silt or sand. Therefore, it is likely that this area would be subjected to erosion from storms or high winds each year.

Eventually the wave activity would tend to consolidate the surface sediments, as they are presently. The location of this CAD away from the most exposed northern edge of this subtidal flat would tend to help dissipate the effects of the waves. As with the other sites discussed, armoring the surface with rock would prevent resuspension of the cap. However, this would prevent recolonization of the cap with the *Ampelisca*-dominated benthic community that is currently abundant in the area. It is unlikely that the *Ampelisca* could recolonize rapidly enough to stabilize the cap before a one-year storm occurred.

Construction of a submerged breakwater northeast of the proposed CAD would help reduce the impact of wave-induced bottom currents.

Indirect Impacts - Downstream Resources

Resources of concern beyond the footprint of the proposed Spectacle Island CAD that could be impacted include soft-shell clam beds, *Ampelisca* beds, winter flounder habitat (coincident with *Ampelisca* beds), lobster habitat, the Central Artery artificial reef and the swimming beach on the southern tip of Spectacle Island. Disposal activities could also present a visual impact to Spectacle Island park users.

Although all the intertidal areas in the vicinity of Spectacle Island are considered to be soft-shell clam beds, harvesting is prohibited on all potentially within the influence of the Spectacle Island CAD. With the elimination of sewage sludge discharge at the end of 1991, and the anticipated elimination of sewage effluent discharge in 1997, this status could change. The eastern shoreline of Spectacle Island is being bermed to protect the island from storm erosion; this area would no longer be able to support clams.

Most sediments dispersed from the disposal event would settle within about 80 m. Site configuration indicates that sediments dispersed from disposal events taking place in the central 18 acres of the CAD would settle primarily within the site boundaries. Vagrant silt from disposal events located in the 27 acres along the perimeter of the site could settle in detectable amounts in an area up to 80 m beyond the site boundaries, encompassing up to 38 acres. This

would form a transient layer about 0.34 cm thick after each disposal event. The high water content in this layer would make it prone to resuspension, so accumulation of a thicker layer would be unlikely.

The distal ends of the sediment plume could reach the intertidal areas of the southeastern and southern sides of Spectacle Island and the northwestern side of Long Island, but at concentrations <0.5 mg/L above ambient.

Impacts to *Ampelisca* beds, winter flounder habitat and lobster habitat would be similar to those described for Subaqueous B, but located in the vicinity of the east side of Spectacle Island (Appendix F).

The proximity of the Spectacle Island CAD to the proposed artificial reef (in the middle portion of Sculpin Ledge Channel) and swimming beach (on the southern tip of Spectacle Island) being developed as part of the mitigation for the Central Artery/Third Harbor Tunnel project is of concern. Dredging is expected to start in 1997, about one year after the deployment of the artificial reef. Critical to the success of the artificial reef is its colonization by "fouling" organisms such as mussels and algae. A prolonged period of increased turbidity caused by elevated suspended sediments could affect the mortality rates of recently settled organisms. Water quality modelling indicated that it is unlikely that the reef would be exposed to elevated concentrations of suspended solids or dissolved contaminants.

The Central Artery project is closing the Spectacle Island landfill and creating a harbor island park. It is expected to be open to the public in 2000. Part of the park design includes a swimming beach at the sheltered southern tip of the island. The swimming beach could be exposed to slightly elevated concentrations of suspended solids (<0.5 mg/L above ambient), but it is unlikely that a plume would be visible. Most constituents modelled would have reached ambient concentrations at this distance from disposal operations. The PAH naphthalene could be present at levels from 1.0 to 2.0 ng/L above ambient in the vicinity of the beach. This is well below concentrations of concern for human health.

Indirect Impacts - Biological Exposure Potential

Water Column Exposure

Like Subaqueous B and E, hydrodynamics at Spectacle Island CAD create a dispersive environment. Water quality modelling predicted that there would be no excessive (i.e., above chronic water quality criteria) buildup of dissolved contaminants. Therefore, it is unlikely that pelagic organisms would be exposed to contaminant levels that would be deleterious to them during disposal operations at Spectacle Island CAD.

Substrate Exposure

As at Subaqueous B, the routine disposal events would tend to preclude colonization of BHNIP silts until the final cap has been put in place for each cell. The absence of food resources and the frequent disturbances at the site would be likely to cause finfish and epibenthic crustaceans from spending prolonged periods of time in a cell until the cell has been closed. Therefore, it is unlikely that organisms would be exposed to the BHNIP silts and their associated contaminants long enough to bioaccumulate contaminants.

Because the transport of resuspended sediments to downstream areas would be less dramatic than the descent of dredged materials, organisms would not be likely to avoid these areas. The sediment-bound contaminant loading described for Subaqueous B would also apply to this site. It is unlikely that hydrodynamic conditions would allow the creation of identifiable deposits of BHNIP silts released during disposal operations.

The temporary change in depth could increase the risk that finfish would enter the pit during the summer months in search of cooler water temperatures and, consequently, be exposed to contaminated sediments. However, monitoring for the Central Artery project and the fall 1994 sampling for the BHNIP suggest that the area around Spectacle Island supports a smaller finfish population than other parts of the Outer Harbor and the Inner Harbor. If this is true, this potential exposure route would present a minimal risk to finfish.

Other Issues

The disposal operations would involve approximately 660 barge trips. This would require Coast Guard coordination of barges with the commercial and recreational boat traffic using the harbor. Construction activities would have a minor adverse aesthetic impact, and result in slightly elevated noise levels.

If the filling is restricted to the depth of the surrounding area, there will be no permanent impact on recreational boating. However, the placement of the material may necessitate temporary restrictions on recreational boating. Because this is a shallow subtidal area, dredging would be required. This will necessitate testing and a determination of the appropriate disposal location for the sediments removed from this site.

The Massachusetts Highway Department (MHD) is currently constructing a dike adjacent to this proposed disposal site for the purpose of containing and closing the landfill at Spectacle Island. Lack of impacts from dredging the CAD on the integrity of the dike structure will need to be demonstrated to the MHD as well as to the owners of Spectacle Island, the City of Boston and the Massachusetts Department of Environmental Protection.

Part of the Spectacle Island Landfill Closure Plan also includes the installation of an artificial reef in the northeastern half of Sculpin Ledge Channel. Depending on the timing of the Project, the fill placement at the Spectacle Island CAD location may need to be coordinated with the construction and/or location of the fish reef to minimize interference and impacts. As mentioned above, if the fish reef is in place during the CAD construction/use, special mitigation measures may be necessary to prevent silt plume exposure to this facility.

MEISBURGER 2 AND MEISBURGER 7

Meisburger 2 is located 2.3 miles southeast of Nahant; Meisburger 7 is located about 7 miles off Boston Harbor. Both occur in water depths of about 80 to 105 feet and were identified as potentially minable sand and gravel deposits (Metcalf and Eddy 1992). Use of either

site for dredged material disposal would require dredging a series of pits, storing the surface materials for future use in capping the BHNIP silts disposed there, and recovering the underlying sand and gravel deposits for beneficial use. From an environmental standpoint, creation of small cells for disposal is preferable to constructing one large pit. Small cells enable capping and isolation of disposed silts more quickly. Subsequent recolonization of the cap can also occur more quickly under this scenario. Because of the water depth, however, the site preparation would be more efficient if surface material was sidecast onto adjacent substrate for storage and then scraped back onto the cell. To minimize the extent of temporary impacts (i.e., smothering) to adjacent substrate, it would be advantageous to dig cells in a planned geometric sequence, placing cap material on top of the next cell to be excavated. This sequence would require that the hopper dredge remain at the site throughout the entire period that disposal of BHNIP sediments occurred.

The specific locations of the sand deposits within the Meisburger 2 and 7 sites would have to be identified prior to any final disposal plan. Because of expected variations in thickness of these minable deposits, it is estimated that the disposal site would encompass an 86-acre area (13 feet below existing substrate) at Meisburger 2 or a 121-acre area at Meisburger 7 (10 feet below existing substrate). Creation of these cells would provide sufficient capacity for 1.3 million cy of silt with a three-foot thick cap. Site bathymetry and surface substrate would be returned to preexisting conditions.

Direct Impacts

Use of Meisburger 2 or Meisburger 7 would result in no permanent loss of aquatic habitat. Benthic production would be temporarily halted during the use of each cell. The existing benthic communities at both sites are a complex array of species and lifestyles (pioneering and later successional stage species co-occur) that would probably take several years to reestablish.

Preexisting bathymetric and substrate conditions would be restored after each cell has been filled. Therefore, use of the site would cause no permanent alteration of the habitat.

The Meisburger 2 and Meisburger 7 sites were both observed to support large lobster fishing efforts in the fall of 1994. Use of either site would disrupt lobstering activities in the footprint and immediately surrounding areas during disposal. Disposal would likely cause lobsters to move out of the immediate area. Development of either site in cells would reduce the likelihood that lobsters or groundfish would move into the pits and be smothered by disposed dredged material. During construction activities, there would be disruption of fishing activities, with an associated economic impact to the fishermen who utilize that area.

Indirect Impacts - Water Quality Effects

The mixing zone required for the high tide disposal of BHNIP sediments at either Meisburger site to dilute total suspended solids to <50 mg/L would be an area of about 22.5 acres (900m by 100m). Concentrations of TSS at these locations would not be influenced by BHNIP dredging activities in the harbor.

Because of the large volume of water available for dilution, no short-term water quality impacts were predicted with the ADDAMS model reported in the DEIR/S. Although about 5% of the sediments from each barge load would be dispersed from either site, no water quality exceedances beyond the disposal site boundary were predicted after four hours under stratified conditions, consistent with Sec. 103 requirements.

Indirect Impacts - Site Stability

The relatively slow bottom currents at Meisburger 2 and 7 (maximum of 0.2 - 0.3 ft/sec [6 - 8 cm/sec]) are unlikely to resuspend silty sediments. Vessel traffic is primarily limited to fishing boats whose relatively shallow draft and low powered engines (compared to cargo vessels) are unlikely to affect the substrate.

However, no land masses protect either Meisburger 2 or 7 from the effects of high winds and storms. A one-year storm could generate bottom currents of 3.2 ft/sec (98 cm/sec) at

Meisburger 2 or 3.6 ft/sec (110 cm/sec) at Meisburger 7. Unconsolidated sediments, such as the silts proposed for disposal, could easily be resuspended under these conditions. Because of the mechanical disruption from dredging, the sediments retained during construction of the borrow pit to be used for the cap would be less compacted than in their original state and, therefore, somewhat more susceptible to resuspension. However, the proposed three foot cap thickness is expected to be sufficient to prevent future exposure of the buried dredged materials.

Indirect Impacts - Downstream Resources

Resources in the vicinity of the Meisburger 2 and 7 sites have been identified through lobster trapping and gill net fishing; demersal fish have not been sampled there because of the presence of fixed fishing gear. Important resources are likely to include lobster habitat, flounder habitat, exploited fishing grounds and the MWRA sewage outfall. The downstream benthic community is assumed to be similar to the conditions observed at Meisburger 2 and 7, that is, diverse and productive.

Discernable downstream impacts would most likely be limited to the immediate vicinity of the disposal site. Although suspended sediments would be transported away from the site during each disposal event, concentrations would be low and settlement would be dependent on prevailing currents at the time of the disposal. The area adjacent to the disposal activities would have the highest likelihood of experiencing increased sedimentation. Depending on the layout of the cells, some material would be likely to settle on other cells.

Lobster and bottom fish that were present at Meisburger 2 or 7 during disposal events would likely move away from the area of increased turbidity. All told, the motile organisms occupying the 86-acre footprint of the Meisburger 2 disposal site, or the 121-acre footprint of the Meisburger 7 disposal site, would be displaced onto adjacent substrate. This could stress the carrying capacity of the adjacent area, although the probability of this is unclear. Areas that also experienced sedimentation would most likely be stressed; benthic standing crop could be diminished.

About half of the area encompassed by Meisburger 2 was identified as having surface substrate conditions that could be appropriate for Early Benthic Phase (EBP) lobsters. Nearly 90% of the substrate observed at Meisburger 7 was gravelly or pebbly in nature, potentially suitable for EBP lobsters. This lifestage has specific habitat requirements, particularly in terms of shelter from predators, that may be the limiting factor in successful recruitment to harvestable lobsters (Wahle and Steneck 1991). Although no EBP lobsters were observed at either Meisburger 2 or 7, this could have been an artifact of sampling design. While it is unlikely that sediments dispersed from the disposal activities outside the disposal cell would blanket a given area thickly enough to destroy the character of the substrate, the increase in the quantity of unconsolidated fine-grained material could affect respiration of EBP lobsters by clogging their gills.

Depending on tidal and seasonal current patterns, effluent from the MWRA outfall and materials dispersed from the disposal activities could interact. Water quality modelling for each project predicts that farfield effects would be negligible. However, these models have yet to be validated. The MWRA outfall is projected to go on line in 1997, the same year that dredging would start in Boston Harbor. Interpretation of results of the stringent monitoring that will accompany the startup of the MWRA discharge offshore would be severely complicated by the presence of disposal activities in such close proximity.

Indirect Impacts - Biological Exposure Potential

Water Column Effects

The rapid dilution of dissolved constituents and suspended sediments following each disposal event would minimize the potential for pelagic organisms to be affected. No constituents are expected to reach concentrations in the water column that exceed the chronic level water quality criteria.

Substrate Effects

Existing sediments near Meisburger 2 (Transect D; MWRA 1988) contain PAHs at concentrations ranging as high as the levels observed in Boston Harbor channels. The sediments potentially proposed for disposal at Meisburger 2 probably contain substantially higher concentrations of contaminants than currently exist there. Therefore, during the relatively brief period that each cell would be uncapped, organisms that contacted the sediments could be affected by the contaminants. However, as described for the In-Channel disposal scenario, there would be several factors operating that would tend to reduce the likelihood of adverse impacts. It is extremely unlikely that benthic organisms would colonize the exposed BHNIP silts because of the relatively short period of exposure (because of construction in cells), the frequency of disturbance, and the character of the local benthic community which consists mostly of later-successional stage species (rather than pioneering species capable of rapid recruitment to disturbed substrates). Absence of food and frequency of disturbance would tend to deter bottom-feeding fish from lingering on the contaminated sediments.

Other Issues

The disposal operations would involve approximately 660 barge trips. This would result a level of traffic that would need to be closely coordinated by the Coast Guard with commercial and recreational boat traffic using the harbor. Construction activities would have a minor adverse aesthetic impact.

The disposal operation at the site would prevent fishing and recreational boating for the duration of the filling activity. A notice to fishermen warning them to avoid this area may be necessary as may be a Coast Guard hazards to navigation notice (due to the regular presence of barges). Although the project activity could provide a point of nuisance to fishermen for 1½ to 2 years, adverse impacts to their fish catch are not anticipated given the relatively small area affected compared to what is available for similar fishing ground. Long-term impacts to the fishery are not expected because the dredge material would be isolated and not exposed to benthos or fish. The proximity of the sites to the MWRA's ocean outfall assures some level of monitoring

(by MWRA) before and during placement of material; any construction impacts from the filling operation could be evaluated from these data.

Use of these locations will entail dredging of existing sand and gravel prior to placement of material. Some of the sand might be suitable for ACOE beach nourishment projects provided it meets grain size, availability and suitability criteria for the specific beach nourishment project. The ACOE is working with the MDC on beach nourishment projects in the Commonwealth including Nantasket Beach, among others. "Piggybacking" projects in this manner is an acceptable strategy to the ACOE. However, costs which must be factored into this option include testing, processing and transporting the material, as well as alternate use or storage costs for that portion of the material not appropriate for beach nourishment.

2.5 SITE EVALUATIONS: SUBAQUEOUS AREAS

2.5.1 Existing Conditions

The site is depicted on Figure A1-18.

2.5.1.1 Subaqueous Containment Site B (Subaq B)

SEDIMENT CHARACTERISTICS

Boring sites ST1-14 and ST1-15, sampled by the CA/T program (Cortell 1990a) and presented in Table A1-16, were located off the northern side of Spectacle Island and represent the same exposure to currents, waves and storms as Subaq B. Surface sediments at ST1-14 and ST1-15 were predominantly sand (77-84%) and gravel (11-20%) with a small silt/clay component (3-5%). Bulk sediment analysis indicated that no parameters exceeded Category I limits.

WATER QUALITY AND CIRCULATION

Waters in the vicinity of the Subaq B site have been classified as Class SB waters by MADEP. Specific water quality data is presented in Section 3.0 for the Outer Harbor area. Typically the greatest impact to water quality in this area is from the numerous discharges and CSO's originating in the Inner Harbor areas. Water quality improves with increasing distance from the Inner Harbor.

The fastest tidal currents in Boston Outer Harbor occur in the deep ship channels (up to 1.4 knots) during spring tides in the southern lane of the Main Ship Channel. The mouth of Dorchester Channel attains spring tide currents of 0.8 knots on ebb tide and 0.6 knots on flood tides (Cortell 1990a). Located near the edge of the Main Ship Channel, Subaq B may experience among the fastest currents.

Subaq B is exposed and vulnerable to northeasterly storms. The nearest sheltering landfall is Deer Island (2.0± miles across the harbor). Nearby sediment conditions indicate the area is occasionally scoured.

AQUATIC RESOURCES

Benthic Infauna

Subtidal benthic macrofauna in the vicinity of the northwest portion of Spectacle Island were examined during benthic infauna and lobster surveys (Cortell 1990a). As with other sampling locations around Spectacle Island, abundances of benthic infauna (retained on a 0.5 mm-mesh sieve) north of the island were low (1113 individuals/m^2). Nematodes, the gastropod *N. trivittatus* and the polychaete *N. caeca* predominated.

Sediment profile camera sampling at Subaq B just south of the shipping channel revealed a silty substrate covered with a mat of *Ampelisca* amphipod tubes (NAI and Diaz 1995). The depth to the RPD layer was more than 2.0 cm below the sediment surface, suggesting well oxygenated sediments. There were indications of subsurface bioturbation, including burrows, worm tubes, and oxic and anoxic voids. Results suggest a healthy benthic community in between pioneering and successional equilibrium stages.

Benthic samples revealed that the amphipod *Ampelisca* sp. predominated, composing 82% of the total abundance (Table A1-10) Total abundance was the highest of all Outer Harbor stations (115,149.6/m^2), and included 60 taxa. Other species such as spionid polychaete *Polydora cornuta* and the amphipod *Phoxocephalus holbolli* composed a small component of the benthic community. Results indicate the benthic community is healthy and diverse, intermediate between disturbed and equilibrium successional stages.

Sediment samples collected during the lobster survey were sieved through a 2.5 mm-mesh sieve and analyzed qualitatively. The polychaetes Nereidae and *Glycera* sp., *Nassarius* sp.

and post-larval crabs were the most frequently collected organisms. Soft-shell clam (*M. arenaria*) spat and razor clams (*E. directus*) were also encountered.

Lobsters

Lobster fishing activity in the vicinity of Subaq B was examined during the summer of 1990 for the CA/T project (Cortell 1990a). Pot markers were observed at Subaq B on each of the three dates examined. Despite being in a navigational channel, pot markers were as numerous at Subaq B as at other areas around Spectacle Island. Transects were swum by divers to document use of the substrate around Spectacle Island by lobsters, including EBP lobster. The greatest density of lobsters was observed off the northeast portion of Spectacle Island (0.0027-0.0035/ft^2). Lobsters occurred at about half that density (about 0.0012/ft^2) off the northwest portion of the island (near Subaq B); abundances elsewhere around the island were generally much lower. Most lobsters were observed at the deeper portions of the transects. No EBP lobsters were observed around Spectacle Island; little suitable habitat was encountered for this lifestage.

Recent lobster trapping surveys at Spectacle Island collected low numbers of lobsters (0.2 per trap-day), one of the lowest in Boston Harbor (Table A1-7). Fishing activity has dropped dramatically as a result of diminished numbers of lobsters. In the trawl survey, approximately 6.7 lobsters were collected per 20 minute tow, similar to that collected at Subaqueous E (Table A1-4).

Finfish

A recent trawl survey near Spectacle Island collected mainly winter flounder, along with skate sp., rainbow smelt, and Atlantic silverside (Table A1-4). The number of fish (21.3 per 20 minute tow) was among the lowest in Boston Harbor.

Based on the on-going development of the artificial reef design, as required by the Individual Permit—Landfill Closure and Maintenance at Spectacle Island for CA/T (ACOE no. 199202207; 2/16/93), target fish species in the offshore coastal waters and Boston Harbor areas

include forage species such as Atlantic menhaden, Atlantic herring and rainbow smelt, and predator species such as winter flounder, striped bass, bluefish, pollock, Atlantic cod, tautog and cunner.

WETLAND RESOURCES

Subaq B is defined as Land Under the Ocean and falls under the jurisdiction of the Massachusetts Wetlands Protection Act (310 CMR 10.00). By definition, this resource is supposed to be significant to the protection of marine fisheries, protection of land containing shellfish, storm damage prevention, flood control and protection of wildlife habitat. Although food resources appear to be limited in this area (low benthic infaunal abundances), the area in the vicinity of Subaq B has been shown to support lobsters and is likely to support winter flounder. The sandy substrate may provide spawning habitat for winter flounder.

The closest significant shellfish resource to Subaq B is in the vicinity of Governors Island Flats across the Main Ship Channel to the north of Subaq B where soft-shell clams are harvested by Master Diggers. The Main Ship Channel influences currents substantially so that Dorchester Channel has little effect north to Governors Island Flats. The tidal flat on the southeastern side of Thompson Island also supports a substantial soft-shell clam resource (Cortell 1990b). Shallow bathymetric conditions between the islands and the configuration and orientation of Spectacle and Thompson Islands result in relatively slow currents passing from Subaq B to the Thompson Island Flats (0.2 knots, spring flood, Cortell 1990b). Spring flood currents through the deeper Dorchester Channel (passing north of Thompson Island) are about 0.5 knots.

Located at the mouth of the Dorchester Channel, Subaq B offers little storm damage protection because its depth is greater than surrounding areas. Storm waves would travel to shallower areas and crest before reaching land. Because it is in relatively open water, Subaq B also has little potential for storing flood water.

Dissipation of storm waves helps to protect shallower areas, such as the subtidal flat southeast of Pleasure Bay. Such shallows can be important feeding resources for waterfowl, including those species observed on and adjacent to Spectacle Island (see next section).

Subaq B is classified as Tidal Waters under federal regulations (33 CFR 328.4(b)). Tidal Waters may provide sediment/toxicant retention, nutrient retention/ transformation, recreation and uniqueness/heritage. Subaq B is not likely to contribute substantially to retention of sediments and toxicants, nor to retention or transformation of nutrients. Relatively swift currents prevent deposition of fine grained sediments that tend to absorb contaminants. Nearby sediments contained only low concentrations of metals and organic pollutants. Recreational vessels are among those using the channel.

WILDLIFE

Waterfowl, including great cormorant (*P. carbo*), herring gull (*L. argentatus*), white winged scoter (*M. deglandi*), common goldeneye (*B. clangula*), bufflehead (*B. albeola*), mallard (*A. platyrhynchos*), black duck (*A. rubripes*), merganser (*Mergus* spp.) and scaup (*Aythya* spp.) have been observed in the vicinity of Spectacle Island (Cortell 1990a). It is likely that these same species of waterfowl use the Subaqueous B site area for feeding and resting. Each of these species feed on fish and invertebrates (Martin et al. 1951; Whitlatch 1982; and DeGraaf and Rudis 1986) that occur in the area.

THREATENED AND ENDANGERED SPECIES

No threatened or endangered species listed by federal or state authorities are identified or anticipated to occur within the boundaries of Subaq B. Several marine mammals not listed as threatened or endangered, including harbor seals (*P. vitulina*), harbor porpoise, (*P. phocena*) and grampuses (*G. griseus*), occur occasionally in the area. These species are all protected under the Federal Marine Mammals Protection Act.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

Previous dredging and maintenance of the Main Ship Channel and the Dorchester Channel have likely disturbed any evidence of historic or archeological remains.

SOCIO-ECONOMIC/LAND USE

Subaq B is an entirely submerged aquatic site within view of Spectacle Island, Thompson Island, Fort Independence on Castle Island, Logan Airport and Deer Island. It lies within a presently marked navigational channel (Dorchester Channel) at its convergence with Western Way and the Main Ship Channel. Lobstermen fish this area.

This open water site is in the path used by the commuter boats to Boston. The site is within 1200 feet of Spectacle Island, an abandoned landfill which is being closed and capped by the Massachusetts Highway Department, and which will be the site of a park owned by the City of Boston and the Commonwealth Department of Environmental Protection. The site is more than one-half mile from the park at Castle Island, an MDC Park and 0.75 miles from Thompson Island.

2.5.1.2 Subaqueous Containment Site E (Subaq E)

The site is depicted on Figure A1-19.

SEDIMENT CHARACTERISTICS

No sediment data were available for the immediate vicinity of Subaq E. Samples collected off the end of Logan Runway 33L (Massport 1990) and from Stations E and F in the Main Ship Channel (ACOE 1988a) may be representative of local conditions. Composed of grey and black oily fine to medium sand, these sediments contained no constituents whose concentrations exceeded the range for Category I sediments. Surface material at Stations E and F in the Main Ship Channel, on the other hand, was ≥85% silt or clay. Bulk sediment analysis indicated that most constituents met Category I standards but lead, chromium and volatile solids occurred at Category II levels.

WATER QUALITY AND CIRCULATION

Water quality in the vicinity of Subaq E is classified as SB. When sampled in 1986, Class SB standards were met except for occasionally excessive bacterial concentrations (Massport 1990). As water quality conditions have been improving throughout the Harbor it is likely that this area will continue to meet SB criteria.

As with other sites in Boston Harbor, the hydrodynamics of Subaq E are governed primarily by tidal currents and secondarily by wind. Bounded to the north and south by shoals, and in close proximity to the Main Ship Channel, Subaq E is subject to relatively high current velocities (up to 1.0 knots flood and 1.3 knots ebb in spring tides). This area experiences a 1.0-mile northeasterly fetch, buffered only by Deer Island, and is exposed to easterly winds. The adjacent shoals crest waves rapidly. Greater depth offers protection to Subaq E.

AQUATIC RESOURCES

Benthic Infauna

Sediment profile camera sampling at Subaq E revealed two habitats. At 4 of the 6 stations, silt substrate was overlain with a matrix of *Ampelisca* sp. tubes (NAI and Diaz 1995). The depth of the RPD layer ranged from 1.4-2.0 cm are below the sediment surface, indicating a healthy degree of sediment oxygenation. There was some evidence of subsurface biological activity, including an occasional worm tube and anoxic void. Benthic sampling results showed the amphipod *Ampelisca* sp. was the dominant organism, composing 45% of the total abundance of 50,987.5/m^2 (Habitat I, Table A1-10). Spionid polychaete *Polydora cornuta* and cirratulid *Tharyx acutus* composed 18% and 12% of the total communities, respectively. The soft-shell clam *Mya arenaria* was collected in low numbers (25/m^2, Table A1-10). Two stations at Subaqueous E had silt substrate, covered either by a matrix of *Ampelisca* sp. tubes or a layer of *Mytilus* shell hash. Where observed, the RPD layer occurred at 2.5 cm below the sediment surface. Worm tubes and oxic and anoxic voids were observed underneath the *Ampelisca* mat, indicating bioturbation activities at depth. Benthic samples contained low numbers of organisms, (975/m^2, the lowest observed in the Outer Harbor area). The mud snail *Nassarius trivittatus* and polychaete *Nephtys ciliata* were the most numerous organisms collected, together composing nearly one half of the sample (Habitat II, Table A1-10). All benthic communities at Subaq E were intermediate between a disturbed or stressed community and an equilibrium community.

Benthic samples at Subaq E contained low numbers of soft shell clam (*M. arenaria*, Table A1-10), although this species tends to be most abundant at and slightly above mean low water. Subaq E is located within approximately 1 nautical mile of the intertidal mud flats, along the perimeter of Logan Airport, which are harvested by commercial clammers. These mudflats also support extensive beds of blue mussels (*M. edulis*), a species also capable of subtidal existence.

Finfish

Subaqueous E

Otter trawl collections in October 1994 collected an average of 82.7 individuals per 20 minute tow, of which 14.7 were lobster (Table A1-4). These catches were the highest of all stations sampled. Winter flounder and skate sp. each composed approximately one third of the catch. Rainbow smelt and Atlantic silverside were secondary dominants.

WETLAND RESOURCES

Like Subaq B, Subaq E includes of Land Under the Ocean (under state jurisdiction) and Tidal Waters (under federal jurisdiction). The Massachusetts Wetlands Protection Act (310 CMR 10.00) assumes that this resource is significant to the protection of marine fisheries, protection of land containing shellfish, storm damage prevention, flood control and protection of wildlife habitat.

Differences in bathymetry and currents between Subaq E and adjacent areas are likely to make it attractive to finfish although it would require more energy to remain in the stronger currents of this channel. Regular tidal currents are likely to prevent anoxic or hypoxic conditions from developing during the summer, enabling finfish to use this area as a refuge from summer temperatures on the adjacent shoals.

The presence of the channel partially diverts tidal energy away from the adjacent shoals. The shoals of Governors Island Flats, in particular, are likely to provide soft shell clam habitat which contributes to the productivity of the area. The abrupt change in depth between Subaq E and Governors Island Flats makes the southern edge of the Flats susceptible to damage from waves generated by easterly and southeasterly winds, however winds from these directions are relatively rare. Governors Island Flats plays a substantial role in protecting intertidal resources and the shoreline from erosional forces by dissipating waves offshore. Like Subaq B, Subaq E is located in open water and has no capacity for storage of flood waters.

Classified as Tidal Waters under federal regulations, Subaq E was evaluated for its ability to provide the functions of sediment/toxicant retention, nutrient retention/transformation, recreation and uniqueness/heritage. Because tidal currents tend to be elevated in channels and keep fine-grained sediments in suspension, it is unlikely that Subaq E contributes to sediment/toxicant retention or nutrient retention/transformation. However, its proximity to commercial anchorages exposes Subaq E to potential spills and accidental discharges. This area is used by recreational boaters for passage into Boston Harbor.

WILDLIFE

Waterfowl, including great cormorant (*P. carbo*), herring gull (*L. argentatus*), white winged scoter (*Melanitta deglandi*), common goldeneye (*B. clangula*), bufflehead (*Bucephala albeola*), mallard (*A. platyrhynchos*), black duck (*A. rubripes*), merganser (*Mergus* spp.) and scaup (*Aytha* spp.) have been observed in the vicinity of Spectacle Island (Cortell 1990a). It is likely that these same species of waterfowl also use the Subaqueous E site for feeding and resting. Each of these species feed on fish and invertebrates (Martin et al. 1951; Whitlatch 1982; and DeGraaf and Rudis 1986) that occur in the general area.

THREATENED AND ENDANGERED SPECIES

No federally or state-listed threatened or endangered species are identified or expected to occur within the vicinity of Subaq E. All marine mammals are protected under the Federal Marine Mammals Protection Act, whether threatened/endangered or not. Three species, harbor seals (*Phoca vitulina*), harbor porpoises (*Phocena phocena*) and grampuses (*Grampus griseus*) occur occasionally in the harbor.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

There are no listed historical or archeological resources at the Subaq B or Subaq E sites.

SOCIO-ECONOMIC/LAND USE

Current use of Subaq E is for navigation between Winthrop Harbor and Boston Harbor (approximately 20 feet MLW). Although entirely submerged, disposal activities at Subaq E would be visible from Deer Island, Winthrop Harbor, Logan Airport, Fort Independence (Castle Island), Spectacle Island and Long Island during construction. Height restrictions may occur because of its proximity to Logan.

This open water site abuts General Anchorage Areas to the south and east and is in the path of the ferries carrying construction personnel to Deer Island during the Boston Harbor Clean-up Project. It is farther removed from the parks discussed with regard to the Subaq B site.

2.5.2 Environmental Consequences of using Subaqueous Containment Sites for Dredged Material Disposal

In order to use either Subaqueous B or E for disposal of silt from the BHNIP, berms (composed of parent material) closing off their open sides would have to be constructed. This berm construction would constitute the extent of site preparation. The nature of these sites would preclude the possibility of filling them in discrete cells. When disposal was complete, the entire area would be capped with sand.

SUBAQUEOUS B

Subaqueous B is located at the mouth of the Dorchester Channel. It is a triangular area with gradually sloping bathymetry to the west and south and open to the Main Ship Channel to the northeast. It has an estimated capacity of 609,000 cy. Including the proposed cap, use of this site for disposal of dredged materials from Boston Harbor would raise the substrate to a final depth of approximately -15 ft MLW.

Direct Impacts

Use of Subaqueous B would permanently cover an 83-acre footprint that was found, in the fall of 1994, to support high abundances of benthic infauna. The predominant organism present in the benthic community was a tube-dwelling amphipod (*Ampelisca* sp.) that is known to be an important prey item for juvenile flounder. This community would be covered and it is unlikely that these organisms could recolonize before disposal was complete. Assuming a sand cap were used to close the site, recolonization would occur. Although use of this site would result in a permanent reduction in depth, it is unlikely that this would have a major effect on the benthic community. It was observed in the fall of 1994 that the benthic community structure at Subaqueous B was very similar to that to the east of Spectacle Island (at Spectacle Island CAD), where water depth ranges from -8 to -12 ft MLW.

Alteration in bathymetric conditions at this site could affect finfish by reducing the bathymetric diversity. During warm summer months, finfish seek cooler waters in deeper areas. A change in depth of 10 feet could make a significant difference in water temperature in the summer at this location.

Either a sand or a clay cap would represent different sediment characteristics than are present at the site now. Because of the local hydrodynamics, it is unlikely that the cap would become heavily silted. Hydrodynamic conditions also indicated that armoring the cap with rock would be necessary. In this case, substrate conditions would change markedly from existing conditions. The rock would support a very different benthic community from that currently

present. As hard substrate is rare subtidally in Boston Harbor, a rock armor would add to habitat diversity in the outer harbor. Shallow rocky subtidal habitat can be highly productive (as the existing habitat appears to be) and support finfish and epibenthic crustaceans. Interstitial spaces between the rocks would tend to accumulate any fine-grained sediments that were transported to the site. These micro-habitats could support soft-substrate benthic species.

Lobster pots were observed in this area in the summer of 1990 (Cortell 1990). Disposal activities would prevent use of the site for the duration of the BHNIP, but closure of the disposal area would allow lobstermen to fish the area in the future.

Indirect Impacts - Water Quality Effects

Analysis of the mixing zone requirements for disposal at Subaqueous B indicated that total suspended solids would be the limiting parameter. After steady state (achieved within about five days of repetitive disposal) is reached, a single disposal event at or around high tide would require a mixing zone of about 26.8 acres (555m by 195 m; Appendix F) before TSS reached a level of 50 mg/L. Disposal at high tide would cause the mixing zone to be oriented along the Main Ship Channel towards the mouth of the Outer Harbor. Dredging for the BHNIP would not interact with the disposal plume at this site.

Repetitive disposal events should have little impact on the water quality of the Outer Harbor (see Appendix F). Assuming daily disposal events, concentrations of total suspended solids and dissolved contaminants would increase for up to a 20-30 day period, and then reach equilibrium. A pollutant transport model analyzing daily disposal of silt at Subaqueous B indicated that, at equilibrium, the maximum concentration of all constituents of concern would be well below the chronic water quality criteria (Table A1-17).

Indirect Impacts - Site Stability

As described for the In-Channel disposal scenario, it is unlikely that upward migration of contaminants through the cap would occur.

Subaqueous B is exposed to erosional hydrodynamic conditions from several sources. Flood and ebb tidal currents exceed speeds of 1.0 ft/sec during spring tides (i.e., at least twice monthly), sufficient to erode silt or sand. Because this site is located within the Dorchester Channel and immediately adjacent to the Main Ship Channel, it is likely that the substrate is exposed to propeller wash from passing ships and boats on a frequent basis and that this would be sufficient to erode material either during disposal or after the cap has been placed. In addition, this site is exposed to storms from the east and northeast. It has been predicted that storms with a frequency of one year could produce bottom currents of up to 0.6 ft/sec (20 cm/sec), sufficient to resuspend silt or sand. Therefore, several hydrodynamic conditions combine to make the stabilization of this site difficult in the short or long term.

Indirect Impacts - Downstream Resources

Downstream biological resources of concern include soft-shell clams, *Ampelisca* beds, winter flounder (in particular, but all finfish occupying the Outer Harbor), and lobsters. Recreational areas include Pleasure Bay, Castle Island and Spectacle Island (the latter park is scheduled to open in 2000). Distribution of clam beds in Boston Harbor is shown in Figure A1-22. Most of the clam beds within one mile of Subaqueous B are currently closed to any type of harvesting, however, it is expected that this status may change with the continued clean up of the Harbor.

The pollutant transport model indicated that transport of silt into these intertidal areas would be unlikely. Silt released into the water column would be most likely to settle to the substrate within about 80 m of the point of disposal in a layer about 0.2 cm (0.5 in) thick. Because of the dimensions of the disposal site, most events would not result in deposition of substantial quantities of vagrant silt outside the disposal site footprint itself. Tidal flow would be

likely to resuspend this material and prevent further accumulation. However, repeated disposal events could result in temporarily reduced benthic productivity in up to 36 acres (a 240-ft wide band surrounding the disposal site).

Recent surveys of benthic communities in the outer harbor have found that the tube-dwelling, mat-forming amphipod *Ampelisca* is a predominant species in most areas examined. Its high abundances appear to be a recent phenomenon that has been linked with the elimination of the sewage sludge discharge from Deer Island. Although this amphipod occupies silty sediments, it requires good water quality conditions. It is unlikely that the minor increase in suspended sediments (7 mg/L above ambient) would affect the existing population of *Ampelisca* or recruitment of juveniles to this area. Any effect would probably be temporary, limited to the disposal period and perhaps six months to a year afterwards (to account for the reproductive cycle of *Ampelisca*).

One of the critical functions that *Ampelisca* beds play is in providing food for juvenile winter flounder. Because juvenile winter flounder are thought to have very small ranges (on the order of 100 m or so), loss of a 36-acre area of *Ampelisca* bed could be deleterious to winter flounder during the project's construction phase. Finfish sampling has not been conducted in the immediate vicinity of Subaqueous B, although it is assumed finfish use is similar to that observed at Subaqueous E (an area of relatively high catches in fall 1994).

As an estuarine species, winter flounder does adapt to periods of high turbidity. Therefore, the dispersion of sediments released during dredged material disposal may have no immediate impact on the distribution of post-juveniles. However, if food resources are destroyed, those lifestages of greater mobility would be likely to move out of the area. If winter flounder spawned in the immediate vicinity of the disposal site, the eggs would potentially be subjected to higher mortality because of elevated sedimentation.It is unlikely that the minor increase in suspended solids would affect either lobsters or lobster fishing. A concentration of 7 mg/L or less would not be visible.

Various recreational activities occur or are planned in the vicinity of Subaqueous B. Pleasure Bay and Spectacle Island are the closest recreational areas to this disposal site. Pleasure

Bay has both a swimming beach and a sailing school. Spectacle Island is planned for general recreation, including swimming, fishing, picnicking and hiking. Disposal activities would be visible from these areas and Castle Island, although no plume would be apparent. Contact with PAHs is a concern for human activities. The most soluble compound, naphthalene, does not have known carcinogenic properties. Because its dissolved concentration is predicted to be < 2.0 ng/L in areas where human contact could occur (e.g. Spectacle Island swimming beach), it is unlikely that any dissolved PAHs would occur at levels of concern. It is unlikely that the disposal activities would interfere or pose any risk to recreational pursuits.

Indirect Impacts - Biological Exposure Potential

Water Column Exposure

Hydrodynamic conditions in the vicinity of Subaqueous B create a dispersive environment, conducive to rapid dilution and transport of water-borne contaminants. Water quality modeling of the material to be disposed indicated that none of the contaminants of concern would reach concentrations within an order of magnitude of the chronic water quality criteria. As ambient water quality in the Outer Harbor has improved substantially since elimination of the Deer Island sewage sludge discharge, it is unlikely that water quality conditions created by disposal of BHNIP silts at Subaqueous B would cause discernible effects in biota exposed in the water column.

Substrate Exposure

Because of the frequency with which disposal activities would take place (one to four times per day), it is unlikely that benthic organisms would be recruited to this disturbed substrate until disposal was complete. In particular, bioassay test results indicate that it is unlikely that *Ampelisca* recruited to the recently disposed sediments could survive. Therefore, there would be little or no opportunity for these infaunal organisms to accumulate contaminants. The absence of infauna, as well as the frequent disposal events, would deter benthic-feeding fish and crustaceans

from spending extended periods associated with the disposed dredged material prior to isolation.

As with the In-Channel disposal scenario, the limited downstream areas subject to sedimentation could have a higher potential for exposing demersal organisms to contaminants. The hydrodynamic conditions in the vicinity of Subaqueous B would tend to cause recently deposited (i.e., uncompacted) sediments in downstream areas to become resuspended and redistributed frequently. Coupled with the fact that the size of the site would require that the dredged material be disposed at multiple locations, it is unlikely that dredged silts dispersed beyond the disposal site would build up on the substrate in a particular area. Sedimentation would not be apparent after cessation of disposal and capping of the site.

Organisms inhabiting the areas subject to temporary sedimentation could be impacted by the half-inch layer of vagrant silt. This layer would contain higher concentrations of contaminants than are presently in the proposed disposal area. Areas exposed to this deposition could experience contaminant-induced elevated mortalities of *Ampelisca* if the silt was present for at least several consecutive days. It is unlikely that this material would remain in place for a sufficient length of time to allow bioaccumulation by other infaunal benthic species. Winter flounder foraging in the area could ingest come sediment as they grazed on *Ampelisca*. In addition, their habit of burying themselves in the sediment would increase the likelihood that winter flounder could experience adverse effects caused by dermal contact, if they remained in the areas subjected to repeated sedimentation.

Other Issues

The proposed project should not adversely impact species considered threatened or endangered by the USFWS, NMFS or MANHESP. Several species that are protected under the Federal Marine Mammals Protection Act (e.g. harbor seals, harbor porpoise) occasionally do occur in this area; these also should not be adversely impacted by the Project.

The proposed project should have no effect upon any structure or site of historic, architectural or archeological significance as defined by MHC or the National Historic Preservation Act of 1966, as amended.

The disposal operations of silt material would involve approximately 450 barge trips. This would result in some delays to commercial and recreational boat traffic using the Harbor. Construction activities would have a minor adverse aesthetic impact, and result in slightly elevated noise levels. The proposed project would be unlikely to have a long-term impact on the soft-shell clam fishery in the vicinity of the site.

If filling is to an elevation below the surrounding bathymetry, there would be no permanent impact harmful to the recreational boaters in this area or to commuter boat traffic using this route to Boston's Inner Harbor. The act of placing the material may disrupt boating activity but only to the extent of requiring vessels to travel around the barge placing the sediments.

SUBAQUEOUS E

The proposed disposal site Subaqueous E is located north of the Main Ship Channel and west of Presidents Roads Anchorage. The site is a rectangular area that forms a depression between Governors Island Flats and Lower Middle. Subaqueous berms would have to be constructed along the east and west ends of the site to contain the silts during disposal. It has an estimated maximum capacity of 614,000 cy of silt. Including a cap, the site would be filled to a final depth of -8 ft MLW.

Direct Impacts

Direct impacts associated with use of Subaqueous E would be the same as those described for Subaqueous B. The 79-acre footprint of Subaqueous E supports an abundant and diverse benthic infaunal community, dominated by *Ampelisca* . Reestablishment of this community would be possible, because the final depth is within the range that was observed to

support this community in the fall of 1994, but it would be dependent on the quality of the final cap. A clay cap could require an extended period of exposure and colonization by pioneering type species before it was suitable for colonization by later successional stages. A sand cap could be more quickly colonized, depending less on physical reworking than the clay cap. However, because of its exposure to tidal currents and storm wave effects, it could be necessary to armor the cap with rock. As with Subaqueous B, a rocky cap could increase the diversity of productive substrate in the outer harbor.

The reduction in depth at Subaqueous E would be unlikely to have an affect on the quality of the benthic community that could exist. It could affect finfish use because it would diminish the small-scale diversity in bathymetry that presently exists, eliminating a potential cooler water refuge during summer months.

Indirect Impacts - Water Quality Effects

The mixing zone around the disposal process at the Subaqueous E site would be best defined by the area needed to dissipate total suspended solids loads to <50 mg/L. Sediments dissipating from the disposal operations at this location would not commingle with sediments escaping the dredging process. Based on disposal at or around high tide, the necessary mixing zone would occupy about 18.0 acres (355m by 210m) and be oriented towards the mouth of the Outer Harbor.

Pollutant transport modelling indicated that released sediments and dissolved contaminants would be rapidly diluted and dispersed. Maximum concentrations predicted after 29 days of daily disposal are listed in Table A1-18.

Indirect Impacts - Site Stability

Subaqueous E would be developed as one large cell. Therefore, all silt disposed at this site would be exposed to prevailing hydrodynamic conditions until the final cap was placed,

a period of about 18 months. As this site is outside of all designated channels, marine traffic is limited to small boats (fishing and recreational vessels) passing through this area in route to the Winthrop Harbor boat ramp and yacht club. These shallow-draft vessels are unlikely to create bottom currents capable of eroding sediments from this site. However, tidal currents at Subaqueous E are estimated to reach up to 2.2 ft/sec (67 cm/sec) on spring ebb tides (slightly lower on flood tides). Although Subaqueous E is located in the lee of Deer Island during northeasterly storms, it is exposed to storms from the east. A one-year storm from this direction could generate bottom currents as high as 0.9 ft/sec (30 cm/sec). Either of these conditions could resuspend and disperse dredged materials disposed at the Subaqueous E site. In fact, these conditions are sufficient to jeopardize the stability of either a sand or clay cap, presenting a long-term risk to the integrity of the disposal site. Therefore, it would be necessary to armor the cap with rock blasted during the dredging of an area at the mouth of Reserved Channel and in the Inner Confluence.

As with other sites described, it is unlikely that contaminants would migrate upwards through the cap. Therefore, since the rock armoring would ensure that the cap stays in place, containing the disposed silts, it is highly unlikely that there would be additional water quality impacts after the site is closed.

Indirect Impacts - Downstream Resources

Resources of concern in the vicinity of Subaqueous E include soft-shell clam beds, *Ampelisca* beds, winter flounder, lobster and recreational fishing. The extensive and highly productive soft-shell clam flats along the shoreline of Governors Island are conditionally open to harvesting (Master Diggers).

The pollutant transport model indicated that most vagrant silt would settle within 80 m of each individual disposal event and reach a maximum thickness of about 0.23 cm (0.6 in). Disposal events centered over about half (32 acres) the area of the site could result in detectable sedimentation outside the defined site footprint. Based on the site configuration, this could affect an area of about 50 acres beyond the footprint of the site. As with Subaqueous B, tidal currents

could resuspend this material rapidly and prevent further build up, although, repeated disposal events could introduce sediments frequently enough to cause a temporary reduction in benthic productivity. These deposited sediments would have higher contaminant concentrations than existing sediments.

Impacts to *Ampelisca beds*, winter flounder and lobster would be the same as discussed for Subaqueous B, although, of course, the impacts would occur in the area in the vicinity of Subaqueous E. This area is shown on Appendix IV. It is unlikely that there would be detectable levels of sedimentation on the clam flats.

Presence of the disposal operation may deter recreational fishermen from fishing in the area whether or not there is visual evidence of disposal (i.e., any plume).

Indirect Impacts - Biological Exposure Potential

Water Column Exposure

Like Subaqueous B, hydrodynamics at Subaqueous E create a dispersive environment. Water quality modelling predicted that there would be no excessive buildup of dissolved contaminants. Therefore, it is unlikely that pelagic organisms would be exposed to contaminant levels that would be deleterious to them during disposal operations at Subaqueous E. Water quality at the clam beds would reflect ambient conditions.

Substrate Exposure

As at Subaqueous B, the routine disposal events would tend to preclude colonization of BHNIP silts until the final cap has been put in place. The absence of food resources and the frequent disturbances at the site would be likely to cause finfish and epibenthic crustaceans from spending prolonged periods of time at the site until the site has been closed. Therefore, it is unlikely that organisms would be exposed to the BHNIP silts and their associated contaminants long enough to bioaccumulate contaminants.

Because the transport of resuspended sediments to downstream areas would be less dramatic than the descent of dredged materials at Subaqueous E, organisms would not be likely to avoid these areas. The sediment-bound contaminant loading described for Subaqueous B would also apply to this site. It is unlikely that hydrodynamic conditions would allow the creation of identifiable deposits of BHNIP silts released during disposal operations.

Other Issues

The proposed project should not adversely impact any species considered threatened or endangered by the USFWS, NMFS and MANHESP. Several species that are protected under the Federal Marine Mammals Protection Act (e.g. harbor seals, harbor porpoise) occur occasionally in this area; construction activities should discourage them from frequenting the immediate project site, thus reducing potential impacts.

The proposed project would have no effect upon any structure or site of historic, architectural or archeological significance as defined by MHC or the National Historic Preservation Act of 1966, as amended.

The disposal operations would involve approximately 423 barge trips. This would result in some delays to commercial and recreational boat traffic using the harbor. Construction activities would have a minor adverse aesthetic impact, and result in slightly elevated noise levels. Any fishing (for lobster, etc.) in the immediate disposal area would have to be curtailed during the disposal period.

If filling occurs to the depths of the surrounding area, there will be no permanent impact on marine traffic. However, during the installation of the material, any marine vessels must circumvent this area to minimize interference with the placement operation.

2.6 SITE EVALUATIONS: EXISTING AQUATIC DISPOSAL SITES

2.6.1 Massachusetts Bay Disposal Site (MBDS)

This site is depicted in Figure A1-21.

2.6.1.1 Existing Conditions

SEDIMENT CHARACTERISTICS

The physical properties of the substrate near the disposal point is varying in composition, predominantly sandy silt, reflecting the various harbor dredging projects disposed here. The natural bottom covering the majority of MBDS (i.e. areas of the silt that have not received dredged material) is a fine silt/clay substrate (ACOE NED unpublished data). The composition of this natural material indicates the basin is a depositional area capable of containing the dredged material. If sufficient currents frequented this area of the basin, the fine grained material would be suspended and transported with the currents. Areas of high current velocities would therefore have a coarse grained (heavier than silt/clay) substrate, a substrate that is not typical of this basin, but is present in the shallow (approximately 60 meter deep) northeast quadrant of MBDS. This area is a rock/cobble/sand area, at the 60 meter isopleth relief west of Stellwagen Bank.

The EPA (1989) evaluated the sediment composition of the MBDS in their draft EIS to evaluate the continued use of the MBDS. The results of the metals analysis show that metal concentrations in the MBDS are either Class I (low) or Class II (moderate) according to the Massachusetts Division of Water Pollution Control guidelines for dredged material. In general these results were similar to levels found outside the disposal site in Massachusetts Bay (EPA 1989). Petroleum hydrocarbons were detected at a higher level within the MBDS than outside. However, polyaromatic hydrocarbons, a measure of the aromatic fraction of petroleum hydrocarbons, was more varied inside than outside the disposal site. Polychlorinated biphenyls

(PCBs) levels on dredged material are somewhat higher than ambient levels. PCB levels detected in dredged material in the vicinity of the MBDS are comparable to levels identified in other Massachusetts Bay studies (EPA 1989).

WATER QUALITY AND CIRCULATION

The oceanography of MBDS is influenced, in part, by the circulation of the Gulf of Maine (SAIC 1993). The Gulf of Maine circulation patterns in the vicinity of the MBDS are modified to a large extent by the presence of Stellwagen Bank on the eastern margin of the Massachusetts Bay. The bank interferes with the exchange of water at depth with the Gulf and the shelf beyond. Stellwagen Bank is a popular fishing and whale watching area. This area was designated as a National Marine Sanctuary on November 4, 1992. The MBDS is located outside the boundary of the Stellwagen Bank National Marine Sanctuary.

Results of MBDS oceanographic studies indicate that the site is located in a low energy, deep water environment, allowing containment of dredged material within the site. Physical oceanographic studies conducted by ACOE NED under the Disposal Area Monitoring System (DAMOS) program as well as those by other investigators have shown that the bottom current velocities at the disposal site are quite low, averaging less than 7 cm/s (Butman 1977; Gilbert 1975; SAIC 1987 and SAIC 1993). This is in general agreement with the current data collected for disposal of dredged material at the MBDS from the construction of the CA/T (EA Engineering, Science, and Technology 1992). Occasional higher velocities, near 20 cm/s in a westerly direction, have been observed in near bottom waters in response to easterly storm events that occurred in fall and winter. Near-bottom currents of this magnitude were not predicted to be strong enough to resuspend sediments at MBDS (EPA 1989).

The temperature/salinity cycle of Massachusetts Bay is characterized by seasonal variability, with maximum temperatures (18°C at surface) typically occurring in a stratified water column during August and September, and minimum temperatures (5°C) typically occurring in an essentially isothermal water column in January and February (SAIC 1987). Salinity values range from 31-33 ppt (SAIC 1987).

AQUATIC RESOURCES

Benthic Infauna

Sampling of the benthos at the MBDS (SAIC 1986) described three distinct community assemblages as occurring. These assemblages reflect the various sediment regimes within the site.

The northeast section of the site has an unimpacted coarse sand and gravel composition. The benthic community, when sampled in the fall of 1985, was numerically dominated by the Syllidae polychaete *Exogone verugera profunda* (907/m^2); the Paraonidae polychaete *Levinsenia gracilis* (350/m^2); and the Spionidae polychaete *Prionospio steenstrupi* (313/m^2). A total of 105 species averaging 4,433 organisms per square meter were recovered.

Rock from the CA/T project was deposited in the northern section of the MBDS. The rock was placed away from the main disposal activity to allow a benthic community to develop providing prey for finfish.

The western portion of the MBDS has been impacted by continued disposal of dredged material from the greater Boston region. Approximately three million cubic yards of dredged material has been disposed in this section of MBDS. This continual disturbance of the bottom maintains the community of benthic organisms in a dynamic equilibrium. The most adaptable species proliferate. Those species that reproduce rapidly and have high numbers of offspring (i.e., larvae) colonize the newly disposed dredged material (r-strategists of classical ecology) and biogenically rework the substrate. Given time, this pioneering community would alter the sediment character and allow a more mature community to develop. The frequent disposal activity maintains the resident population of the disposed material area as a pioneering sere. This assemblage at MBDS was dominated (in fall 1986) by oligochaetes (6,293/m^2); the Spionidae polychaete *Spio pettibonae* (4,607/m^2); the Cirratulidae polychaete *Chaetozone setosa* (2,160/m^2); and the Capitellidae polychaete *Metiomastus ambiseta* (1,757/m^2). A total of 78 species averaging 25,467 organisms per square meter were recovered.

The southeastern section of MBDS has an unimpacted silt/clay sediment make-up. The lack of physical disturbance (burial) by disposal of dredged material has allowed a mature benthic assemblage to become established. Interspecific competition within a mature community results in a presence of considerably lower densities of individuals (e.g. 8,390/m^2) than found in continually disturbed habitats (e.g. 25,467/m^2). The undisturbed southeastern section of MBDS was dominated by the Paraonitae polychaete *Levinsenia gracilis* (1,583/m^2); oligochaetes (1,050/m^2); and the Capitellidae polchaete *Mediomastus ambiseta* (693/m^2). The fall 1985 sampling in this section of MBDS recovered a total of 57 species averaging 8,390 individuals per square meter.

The August 1990 bathymetric and REMOTS sediment profile surveys conducted at MBDS confirmed that the dredged material formed a deposit one meter high at the mound center (SAIC 1993). Despite the large amount of material (over 340,000 cubic yards) deposited at the site since November 1988, the REMOTS photography indicate a steady recovery of the benthic ecosystem. This was indicated by a steady increase in Stage III taxa (large burrowing deposit feeders, i.e. climax community) (SAIC 1993).

Finfish

Various finfish species have been collected within the MBDS (SAIC 1986, SAIC 1985, EPA 1989). In the spring of 1985, the spiny dogfish was the dominant finfish recovered. This species migrates seasonally in large schools. Those sampled at MBDS were found to be feeding on flounder, sculpin, and anemones. Fall 1985 finfish collections were dominated by the witch flounder or grey sole and the dab or American plaice. The former was found to be foraging on polychaetes (e.g. *Chaetozone* sp.; *Spio* sp.; *Sternapsis* sp. and *Tharyx* sp.). The latter was found to be foraging on brittle stars (Ophiuroidea). Other important species include redfish, ocean pout, cusk, and Atlantic wolffish. Silver and red hake are abundant, commercially important seasonal migrants.

WETLAND RESOURCES

There are no protectable wetland resources subject to federal or state jurisdiction at MBDS.

WILDLIFE

Approximately 35 species of marine mammals, 5 species of marine turtles and 40 species of seabirds occur within the Gulf of Maine. Aerial surveys were conducted for the ACOE to assess the use of the Massachusetts Bay Disposal Site (MBDS) by marine mammals, reptiles and seabirds (MBO 1987).

Seabirds observed include northern fulmar (*Fulmanus glacialis*), shearwater (*Puffinus* sp.), storm petrels (Hydrobatrae), northern gaument (*Sila bacsaus*), Pomarine jaeger (*Steriovarius pomarinum*), gulls (Larinae) and Alcids (Alcidae). Dominant nonendangered mammals include minke whale (*Belasnoptera acutorostrata*), white-sided dolphin (*Lagenorhynchus acutus*), and harbor porpoise (*Phocena phocena*). Although five species of turtles potentially could occur on Massachusetts Bay, only the leatherback turtle (*Dermochelys coriacea*) is typical in the area.

THREATENED AND ENDANGERED SPECIES

MBDS is located in Massachusetts Bay, an area known to be utilized by various marine mammals, but outside (just west of) the boundaries of the Stellwagen Bank national marine sanctuary. Endangered whale species are known to congregate above the shallow (30 meter) Stellwagen Bank (U.R.I. 1981) when foraging for prey (e.g. sand lance *Ammontytes americanus*). These species also have been observed within the two nautical mile circular boundary of the MBDS. Endangered species identified as transients of MBDS include the finback whale *Balaenoptera physalus*; the sei whale *Balaenoptera borealis*; the humpback whale *Megaptera novaeangliae* and possibly the northern right whale *Eubalaena glacialis* (MBO 1987). The impact of the use of the MBDS on endangered species is currently being assessed by the ACOE NED. Use of the site to date has not indicated any impact to threatened or endangered species. Full

coordination with the NMFS ensures compliance with the protection of endangered species and their habitats.

Cetaceans are transients of the disposal site, but are not likely to be to impacted by ocean disposal. Some threatened or endangered turtles (i.e., leatherback, Kemp's ridley and loggerhead) have been recovered in this region as well. If any transient endangered species entered the area during the project operation, they should be able to avoid the dredging or disposal activity. Disposal of dredged material at the MBDS is not expected to have an adverse impact on endangered species, their prey, or the habitat essential for their survival. Consultation with the NMFS under Section 7 of the Endangered Species Act of 1973 (as amended, 16 U.S.C. 1531 et seq), has been initiated to ensure this activity will not jeopardize any endangered or threatened species.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

The MBDS has been used for disposal of dredged material since the 1940's. No historical or archeological resources are expected to occur at the site. Consultation with EPA during the designation of the MBDS with the Massachusetts Board of Underwater Archeology indicated that no known historical shipwrecks exist at or near the site.

SOCIO-ECONOMIC/LAND USE

MBDS is an active disposal site that has been in use for several decades. Extensive shipping, fishing, recreational activities, and scientific investigations take place in Massachusetts Bay year around. There are no known interferences from disposal events on these activities (EPA ROD 1993). In addition, the availability of the MBDS for the vast majority of sediments from Boston Harbor provides an engineering, social, environmental, and economic solution for the disposal of such a large amount of material.

2.6.1.2 **Environmental Consequences**

SEDIMENT CHARACTERISTICS

MBDS has been extensively studied by the ACOE NED. Precision bathymetry, sediment grab sampling and REMOTS image analysis (sediment profiling) have characterized this site as a low energy environment suitable for dredged material disposal and containment. Additional oceanographic sampling has been conducted to designate MBDS as an ocean dredged material disposal site.

The MBDS is the only U.S. EPA designated dredged material disposal site in the Boston Harbor/Massachusetts Bay area. This site annually receives approximately 300,000 cubic yards of dredged material with the exception of this project. However, this figure is expected to decrease for two reasons. First, more stringent biological testing for open water disposal of dredged material means more material will not be acceptable for open water disposal. In addition, the recent designation of the MBDS by EPA states that no capping of unsuitable material is allowed at the MBDS until it can be demonstrated that capping can isolate unsuitable material from the benthic community. Until this can be demonstrated to the satisfaction of the EPA and other appropriate agencies, capping would not occur. Since much of the silt material dredged from the Boston Harbor area is unsuitable, this site would be used primarily for parent material. The ACOE NED has successfully completed many capping projects in New England and believes capping is a viable option at the MBDS. Although no capping of unsuitable material will occur for the Boston Harbor navigation improvement project at the MBDS, questions raised by EPA about capping are addressed in Appendix F. Future use of the site may be considered if the efficacy of capping can be demonstrated.

Approximately 2.0 million cubic yards of dredged material (parent material) could be disposed at the MBDS. The material dredged from the proposed channels will be placed on barges and transported (approximately 1500 trips) to MBDS. The disposal will occur by bringing the barge to a complete stop at the predescribed point. This disposal point will be marked by a buoy positioned by the ACOE NED. The discharge will occur in approximately 100 meters of water.

WATER QUALITY AND CIRCULATION

A turbidity plume will be created by the disposal of the dredged material. During descent, some of the fine-grained sediment separate from the plume and remain in suspension. The amount of material that is dispersed in the disposal plume is dependent upon the physical characteristics of the sediment, the volume of material disposed, and method of disposal, and typically ranges from 3 to 5% (WES 1986).

Recent studies (SAIC 1985) concluded that the concentration of suspended materials in the turbidity plume, following disposal, will be no greater than 5 to 12 mg/l forty minutes after disposal. These studies were conducted at the MBDS with hydraulically dredged material disposed in 100 meters of water. This method of dredging mixes the sediment with water to form a slurry. The disposal of this mixture represents the maximum possible suspension of material. The bucket dredging technique to be used for this project will maintain the disposal sediments in a cohesive mass, greatly reducing turbidity potentials.

Dredged material which settles on the bottom at MBDS can be expected to remain in place. Near bottom currents are low, averaging less than 7 cm/s (EPA, 1989). Resuspension from storm events is rare and typically results in resuspension of only 4% of the surficial material.

As the material descends through the water column, some of the chemicals adsorbed to the fine particulates may be eluted from the dredged material. The concentration values in the turbidity plume will be considerably less than the bulk chemistry concentrations in the dredged material, since most of the material will remain consolidated. Due to the low natural levels of metals and other chemicals in the clay, the water quality impact, if any, will be contained within the disposal site. EPA determined that water quality impacts from disposal events are temporary and limited to the period immediately following the disposal (EPA 1989).

Recent studies (EPA 1993) for the MWRA offshore outfall impacts evaluated water quality impacts at MBDS from the BHNIP, using the ADDAM's model with input assumptions

and data from this study. In that report, EPA found no water quality criteria exceedances outside the mixing zone (disposal site) for the MBDS after four hours.

Physical parameters such as currents, waves, and tidal circulations have been closely monitored for the site (SAIC 1985). This area has contained dredged material on site and does not disperse sediment or chemicals to affect ambient environments. In general, the proposed disposal of an estimated 1.8 million cubic yards of material dredged from the project area will not significantly impact the disposal site given its physical, chemical and biological characteristics and general history of use.

AQUATIC RESOURCES

Benthic Infauna

The disposal site has been used for dredged material disposal for a number of years. Disposing sediments at site buries the organisms inhabiting the impact area. This burial process has been of sufficient frequency at MBDS to maintain a disturbed environment at the point of disposal. A specialized population of benthic species have successfully exploited this disturbed niche and rapidly provide biomass and bioturbation to the newly disposed material. These pioneering organisms are already established on the disposal site (SAIC 1985) and their action can quickly rework the newly deposited sediments. The disposal of dredged sediments would bury non-motile and larval/juvenile organisms at MBDS. The same pioneering species can quickly inhabit the newly disposed material by larval and adult recruitment. The overall process of maintaining a disturbed habitat would provide a productive benthic environment for organisms that rework the substrate. This biological mining of the substrates (bioturbation) homogenizes and oxygenates the upper few centimeters of the sediment. This can allow other organisms to begin inhabiting the substrate (colonization). Larvae settle and metamorphize and adults emigrate into the area, all contributing to restore benthic productivity.

Finfish

Disposal of dredged material will have a temporary impact on finfish at the site. Adverse impacts to individual organisms could occur but are not expected to be substantial considering the mobile nature of fish. Temporary impacts are expected to come from the temporary loss of benthic species for foraging. Due to the already disturbed nature of the site and the quick recolonizing ability of benthic organisms, recovery should occur in the short-term. Any changes in benthic community structure should be localized and, with respect to fisheries resources, have little effect on a baywide basis.

WETLAND RESOURCES

Since there are no regulated federal or state wetland resources associated with MBDS, no impacts will occur.

WILDLIFE

No impacts are anticipated to the existing wildlife at MBDS.

THREATENED AND ENDANGERED SPECIES

Several endangered whale and turtle species can occur in the Massachusetts and Cape Cod Bays. Endangered whale species have been observed within the two nautical mile circular boundary of the MBDS. The impact of the use of the MBDS on endangered species is currently being assessed by ACOE NED. Use of the site to date has not indicated any impact to threatened or endangered species. Full coordination with the NMFS ensures compliance with the protection of endangered species and their habitats.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

No impacts are anticipated, since no historical or archeological resources of record exist at MBDS.

SOCIO-ECONOMIC/LAND USE

Since MBDS is an active dredge material site, no additional impacts are expected to site usage or commerce than may presently exist.

2.6.2 Boston Lightship Disposal Site (BLDS)

The site is depicted on Figure A1-21.

BLDS is a historic area for dumping of various materials (e.g., barrels). Therefore, prior to any disposal of dredge materials at BLDS, surveys to determine where, if any, barrels occur in the disposal site, and hydrographic surveys of the area, are needed to determine if the site is stable. BLDS is an area for which previously collected sidescan sonar records are being analyzed by the United States Geological Survey to map acoustic patterns and related sedimentary environments (Butman et al. 1992).

2.6.2.1 Existing Conditions

SEDIMENT CHARACTERISTICS

Information collected under the DAMOS (1979a) program indicate that the heavy metal content of the sediments collected from the disposal site were among the highest found in the study between the two Massachusetts Bay Disposal sites. Even still, comparison of the sediment chemistry results with the Massachusetts Dredged Material guidelines show that the metal concentration would be classified as Class I (low).

WATER QUALITY AND CIRCULATION

Water quality and circulation conditions at BLDS are presumed to be similar to those at MBDS. Both the MBDS and Boston Lightship are reported to have extremely weak tidal current but could be subject to some wave motion (DAMOS, 1979a).

AQUATIC RESOURCES

Benthic Infauna

A summary of the benthic species collected at BLDS in December of 1977 and May of 1978 indicate a smaller number of individuals and species than at other disposal sites located in the Gulf of Maine (DAMOS 1979b). Dominant benthic species include the polychaetes *Sternapsis scutata*, *Nepthys incisa*, *Maldane sarsi*, *Lumbrineris fragilis*, *Ninoe nigrippes*, *Goniada maculata*, *Ampharete acutifronons*, nemertean worm *Micrura* sp., burrowing anemone *Edwardsia elegans*, and the amphipod *Hippomedon serratus* (DAMOS 1979a).

Mussels (*Modiolus modiolus*) were deployed at BLDS in 1978 to monitor temporal and spatial variations in ambient metal and other chemical concentrations in the sediments (DAMOS 1979b). Results indicated that the mussels at BLDS had metal concentrations which approximated those in animals at Halfway Rock, a reference site. Data indicates that the reference population at Halfway Rock, being closer to terrestrial sources of contamination, is probably exposed to similar or higher concentrations of some trace metals than the mussels held at the disposal site (DAMOS 1979b). However, subsequent samples taken from both the reference and disposal site showed increases of the disposal site concentrations over those of the reference station.

Sediment profile camera sampling at the Boston Lightship revealed a healthy benthic community. Nearly three-quarters of the areas sampled had predominantly fine sand substrate over silt (indicating a depositional environment), with a few areas that were solely sand or silt clay (NAI and Diaz 1995). The depth to the RPD layer was at least 1 cm, indicating sediments were well oxygenated. The sediment surface was diverse, and contained topographic features such as pits, mounds, bedforms, and clasts. Worm tubes were observed on the sediment surface; burrows were occasionally observed at depth. Total abundance of the benthic community was 9,066/m^2, moderately high among the offshore stations (Habitat VII, Table A1-10). The 125 taxa collected in the 8 samples were mainly opportunistic, surface-dwelling polychaetes. The most abundant species, *Spio limicola*, represented 47% of the total abundance. Secondary dominants included *Mediomastus californiensis* (7% of the total abundance) and *Prionospio steenstrupi* (6%). The

benthic community at Boston Lightship could be considered to be at a successional stage beyond pioneering but not yet at equilibrium. Monitoring in August 1994 (SAIC 1994) noted a somewhat healthier benthic community, as indicated by deep-dwelling benthic fauna such as holothuroids, which were not collected in the October survey. The remaining stations mainly had fine sand sediments overlying silt with pit and mound topography. The depth of the RPD layer was 1.5-2.5 cm below the sediment surface. Other characteristics were consistent with the majority of the stations. The benthic community had one of the lowest total abundances (4732.7/m^2) of all Outer Harbor stations (Habitat VIII, Table A1-10). A total of 76 taxa were collected in the 3 0.04-m^2 samples. *Spio limicola* was the most abundant species, representing 21% of the total abundance.

Finfish

The Massachusetts Bay area is a productive fishery habitat. Fish reported to occur in the area of the disposal site include cod, dab and gray sole, yellowtail flounder, whiting, and Atlantic herring; all are caught near the vicinity of the Boston Lightship and the MBDS (DAMOS 1979a). Lobster and ocean quahogs are also reported in the area.

WETLAND RESOURCES

There are no protectable wetland resources subject to federal or state jurisdiction at BLDS.

WILDLIFE

Wildlife, including great cormorant (*P. carbo*), herring gull (*L. argentatus*), white winged scoter (*M. deglandi*), common goldeneye (*B. clangula*), bufflehead (*B. albeola*), mallard (*A. platyrhynchos*), black duck (*A. Rubripes*), merganser (*Mergus* spp.) and scaup (*Aythya* spp.) are likely to intermittently utilize BLDS for feeding and resting. Each of these species feed on

fish and invertebrates (Martin et al. 1951; Whitlatch 1982; DeGraaf and Rudis 1986) that occur in the area.

THREATENED AND ENDANGERED SPECIES

BLDS is located in Massachusetts Bay, an area known to be utilized by various marine mammals, but outside the boundaries of the Stellwagen Bank National Marine Sanctuary. Cetaceans are transients of the disposal site, but are not likely to be impacted by ocean disposal. Endangered whale species are known to congregate above the shallow (30 meter) Stellwagen Bank (U.R.I. 1981) when foraging for prey (e.g., sand lance *Ammontytes americanus*). Endangered species presumed to be transients at BLDS include the finback whale *Balaenoptera physalus*; the sei whale *Balaenoptera borealis*; the humpback whale *Megaptera novaeangliae* and possibly the northern right whale *Eubalaena glacialis* (MBO 1987). Threatened or endangered turtles could transit this area as well. The impact of the use of Boston Lightship on endangered species is currently being assessed by ACOE NED. Boston Lightship is further removed from the prime threatened and endangered species habitat at Stellwagen Bank. Use of the site to date has not indicated any impact to threatened or endangered species. Full coordination with the NMFS ensures compliance with the protection of endangered species and their habitats.

HISTORICAL AND ARCHEOLOGICAL RESOURCES

BLDS has historically been used for disposal of dredged material. No historical or archeological resources are expected to occur at the site.

SOCIO-ECONOMIC/LAND USE

Extensive shipping, fishing, recreational activities, and scientific investigations take place in Massachusetts Bay year round. There are no known interferences from disposal events on these activities (EPA ROD 1993). In addition, the availability of the BLDS for the vast

majority of sediments from Boston Harbor provides a potential solution for the disposal of large amounts of dredged material.

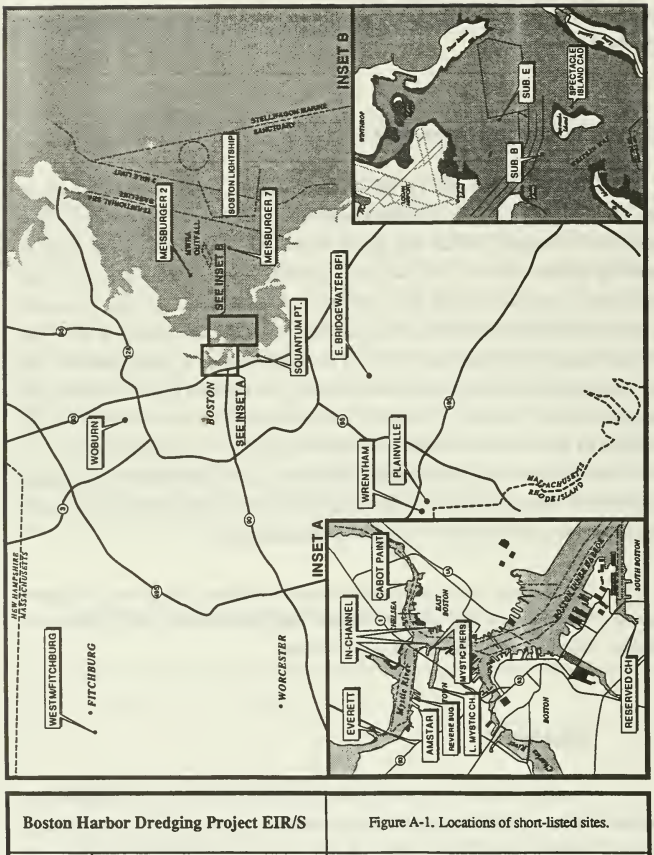
2.6.2.2 Environmental Consequences

Boston Lightship (BLS) is the only previously-used dredged material disposal site being considered for the disposal of silts from the BHNIP. In addition to disposal of three million cubic yards of dredged materials from Boston Harbor through the 1970s, waste containers containing hazardous and low level radioactive materials, as well as construction debris and sunken vessels, have been dumped at this site. The EPA has conducted, and plans to continue to conduct, investigations on the nature and condition of the chemicals disposed at BLS. The EPA has expressed reservations about the use of this site for disposal of dredged materials until their investigations have been concluded and evaluated. The following analysis is based on the assumption that the conclusion of the EPA's studies will indicate that the material previously dumped at the site would pose no hindrances to future use for disposal of dredged materials. That is, the question of restrictions caused by the existing barrels will be deferred until the evaluation of practicability criteria. The discussion in this section will focus on the suitability of the natural physical and biological environment to support the proposed activity.

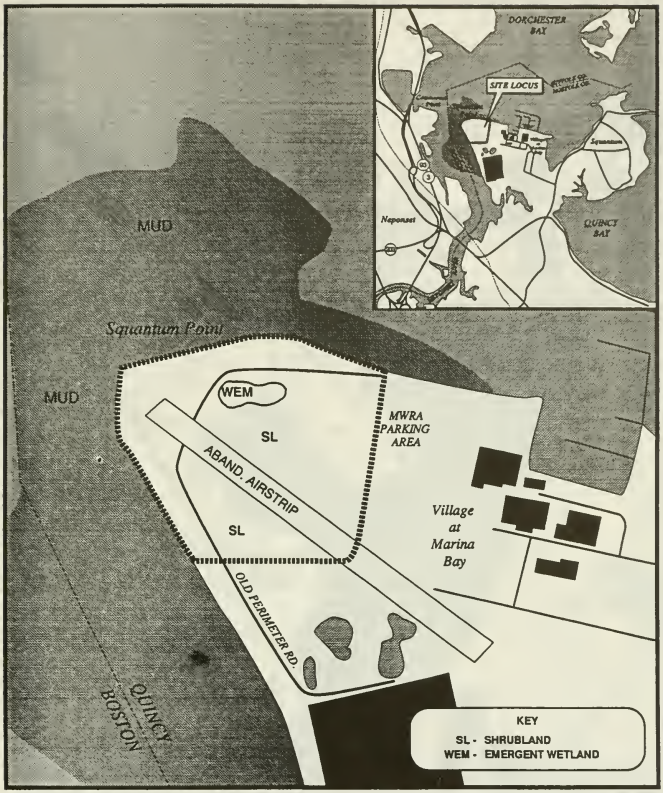
The site would require no preparation other than placing a buoy to mark the disposal location. Dredged material (silt) would be disposed from barges directly onto the unmodified substrate. The silt would be capped with parent material.

Direct Impacts

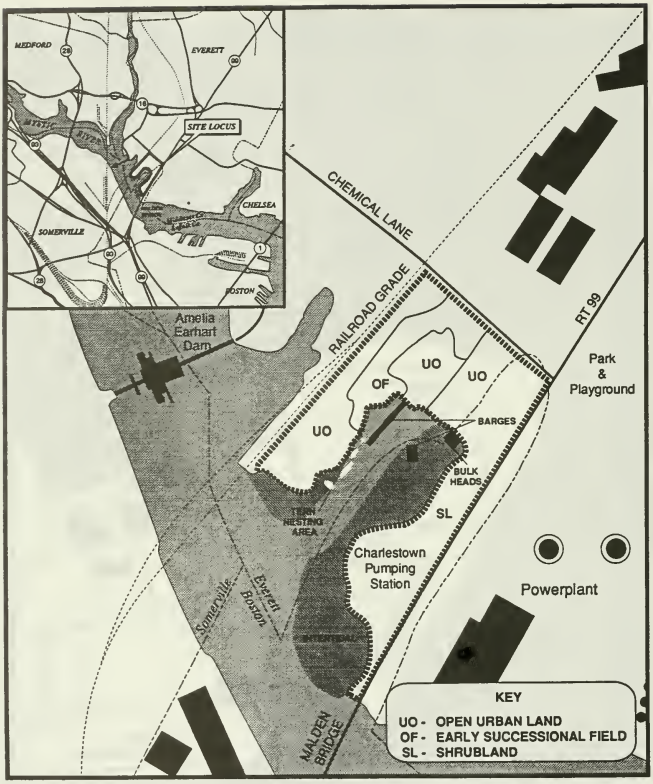
Because this site is in a depositional environment (Knebel 1993), it is expected that the disposed dredged material would settle onto the substrate in a mound. SAIC (1994) identified deposits of dredged materials dating back to at least the 1970s. The benthic resources in the footprint of the mound would be smothered. The existing character of the substrate is predominantly hard sand colonized by a diverse benthic infaunal community. Disposal of silts



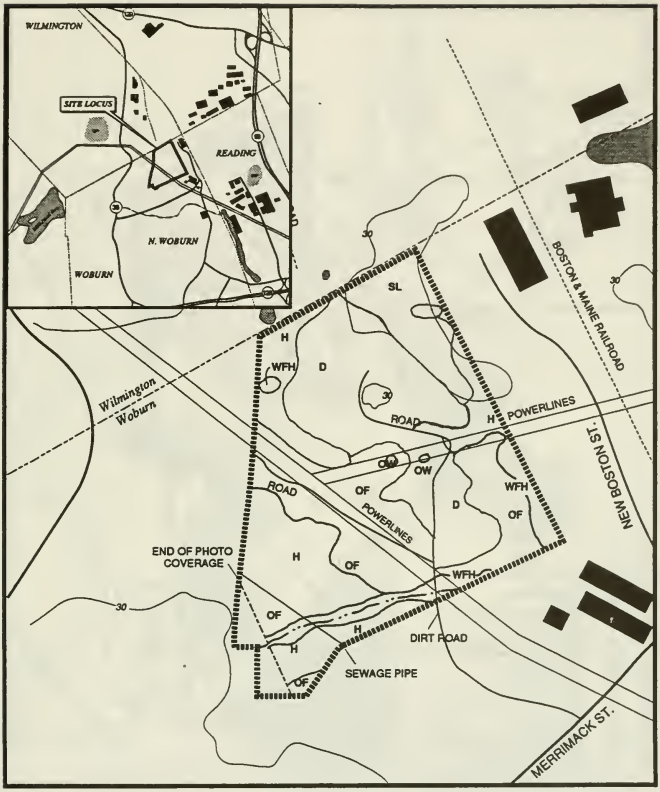
Boston Harbor Dredging Project EIR/S	Figure A-1. Locations of short-listed sites.
Scale: 0 10 Approx. Scale in Miles	Source: USGS Quadrangles Revised by NAI to reflect pertinent site conditions.



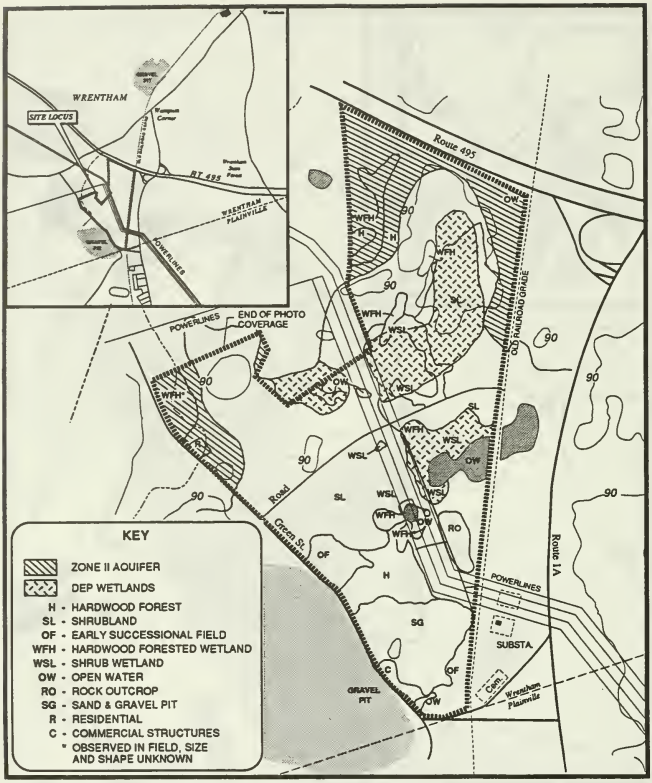
Boston Harbor Dredging Project EIR/S	Figure A1-2. Site map for potential disposal site, Quincy-03 (Squantum Point).
N Scale: 0 100 200 Scale in Meters	Source: USGS Quadrangle Boston South, MA, 1987 Revised by NAI to Reflect Pertinent Site Conditions



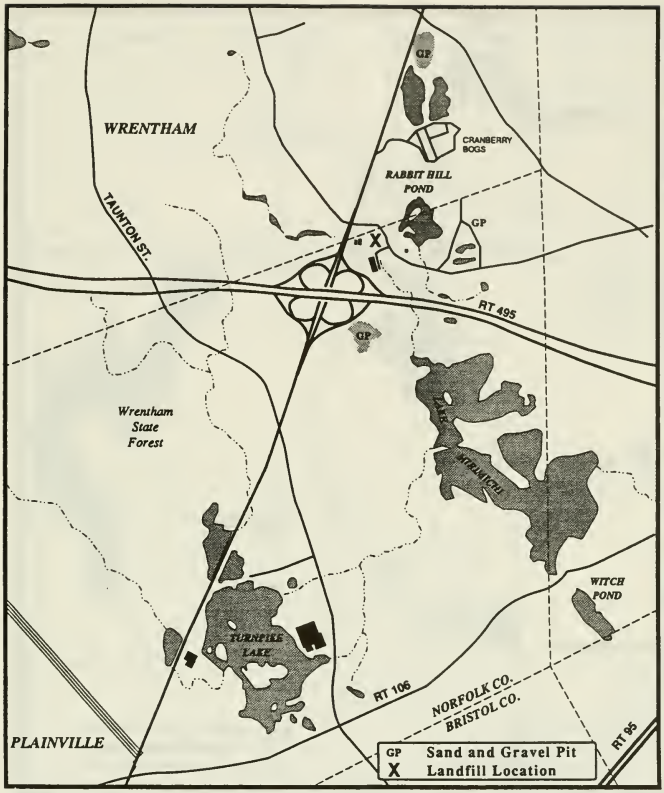
Boston Harbor Dredging Project EIR/S	Figure A1-3. Site map for potential disposal site, Everett.
N Scale: 0 100 200 Scale in Meters	Source: USGS Quadrangle North Boston, MA, 1985 Revised by NAI to Reflect Pertinent Site Conditions



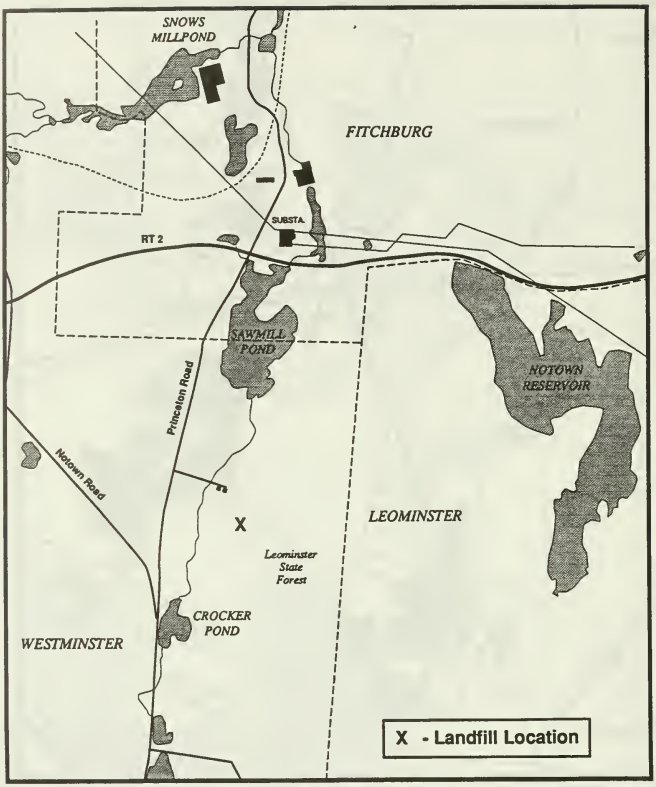
Boston Harbor Dredging Project EIR/S	Figure A1-4. Site map for potential disposal site, Woburn-11.
N *Scale:* 0 100 200 *Scale in Meters*	*Source:* USGS Quadrangle Reading, MA, 1987 Revised by NAI to reflect pertinent site conditions



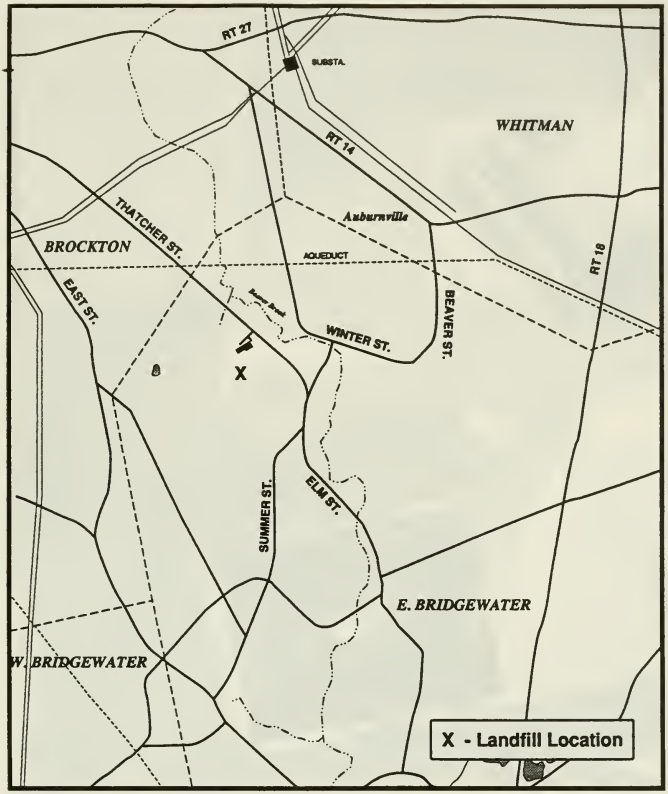
Boston Harbor Dredging Project EIR/S	Figure A1-5. Site map for potential disposal site, Wrentham-495.
N *Scale:* 0 100 200 Scale in Meters	*Source:* USGS Quadrangle Franklin, MA 1987 Revised by NAI to reflect pertinent site conditions.



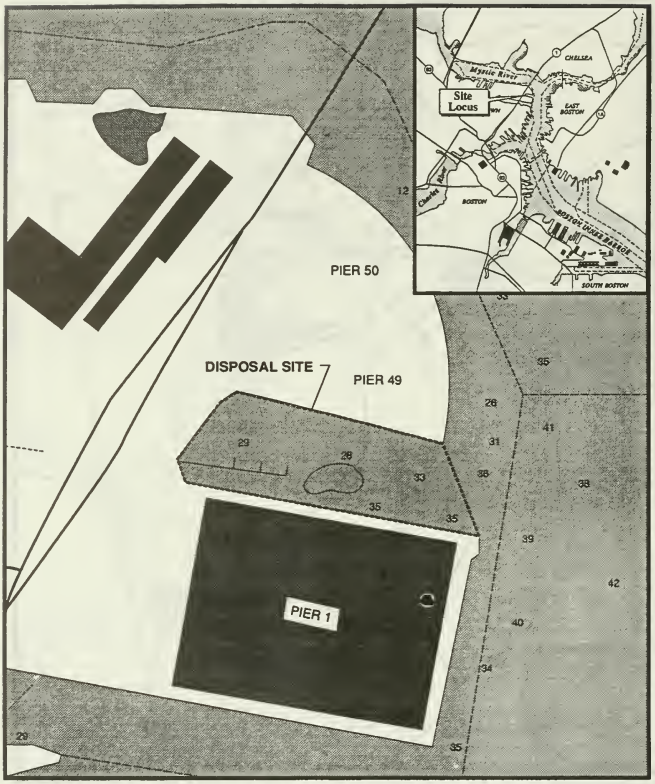
Boston Harbor Dredging Project EIR/S	Figure A1-6. Site map for the Plainville Landfill site.
N Scale: 0 1000 2000 Scale in Feet	Source: USGS Quadrangle Franklin, MA 1987 Revised by NAI to reflect pertinent site conditions.



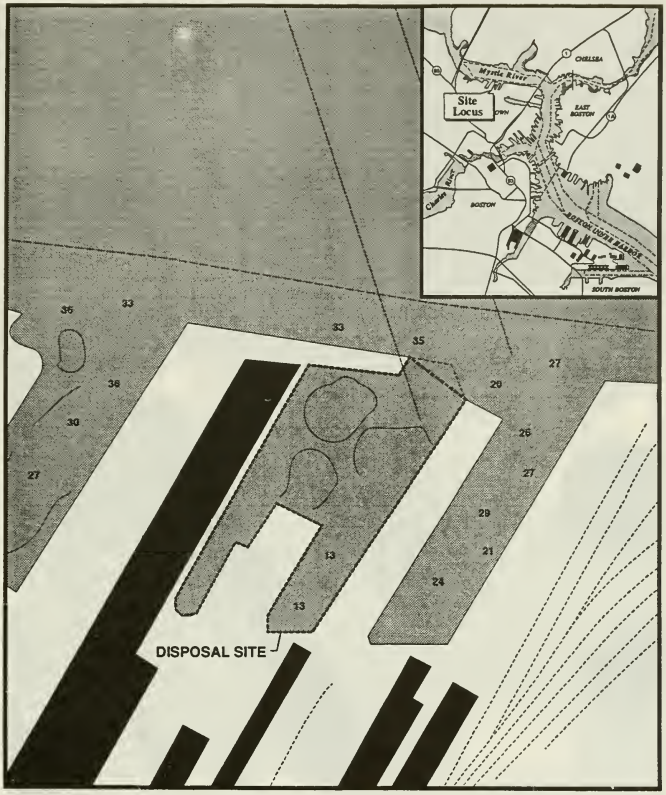
Boston Harbor Dredging Project EIR/S	Figure A1-7. Site map for the Fitchburg/ Westminster Landfill site.
N Scale: 0 1000 2000 Scale in Feet	Source: USGS Quadrangle Fitchburg, MA 1988 Revised by NAI to reflect pertinent site conditions.



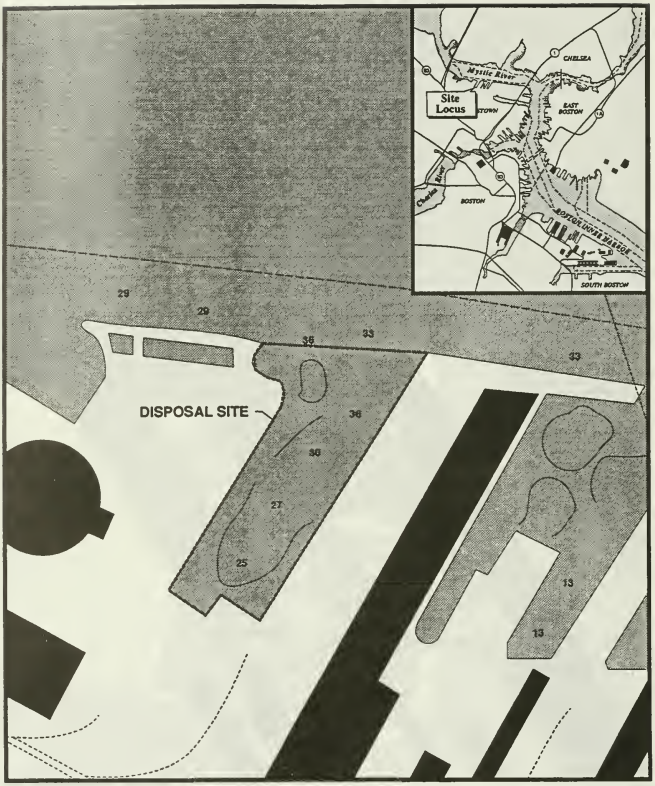
Boston Harbor Dredging Project EIR/S	Figure A1-8. Site map for BFI Northern Disposal Inc. (E. Bridgewater) Landfill site.
N	*Scale:* 0 1000 2000 Scale in Feet
	Source: USGS Quadrangle Whitman, MA 1977 Revised by NAI to reflect pertinent site conditions.



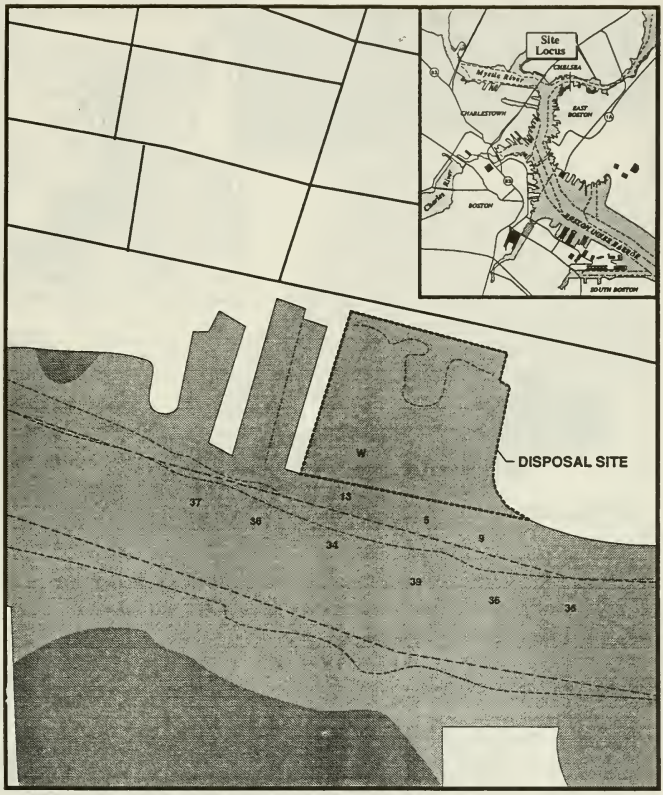
Boston Harbor Dredging Project EIR/S	Figure A1-9. Site map for Mystic Piers site
N Scale: 0 50 100 Scale in Yards	Source: Boston Harbor Navigation Chart



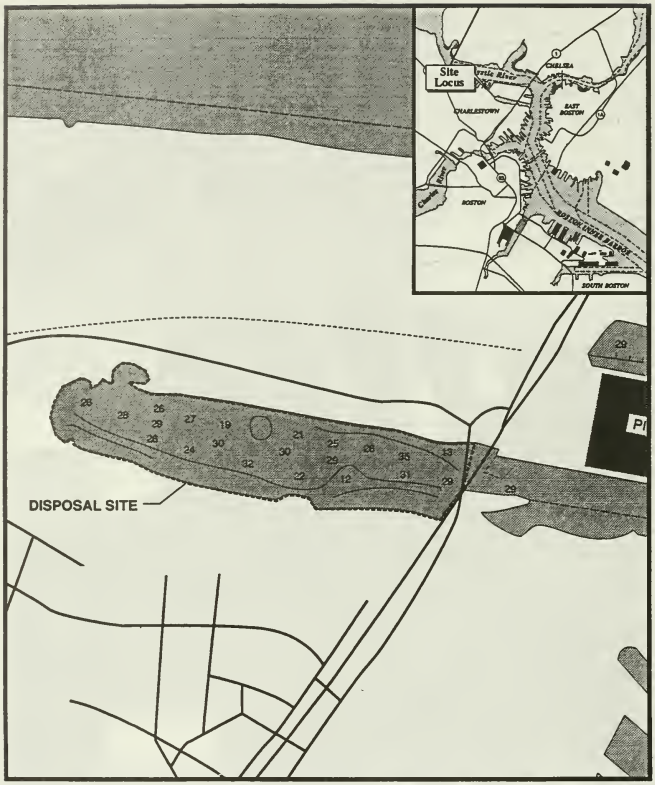
Boston Harbor Dredging Project EIR/S	Figure A1-10. Site map for Revere Sugar site
N Scale: 0 50 100 Scale in Yards	Source: Boston Harbor Navigation Chart



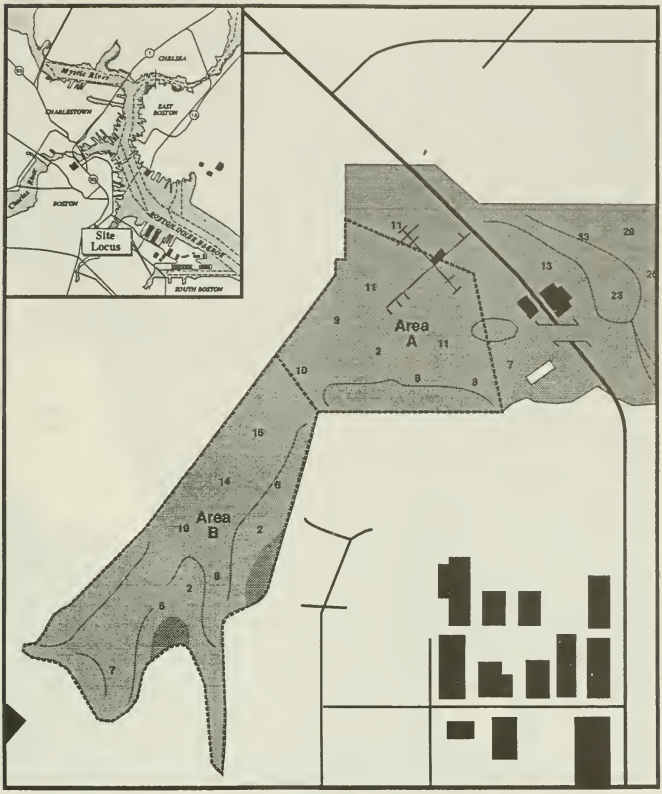
Boston Harbor Dredging Project EIR/S	Figure A1-11. Site map for Amstar site
N Scale: 0 50 100 Scale in Yards	Source: Boston Harbor Navigation Chart



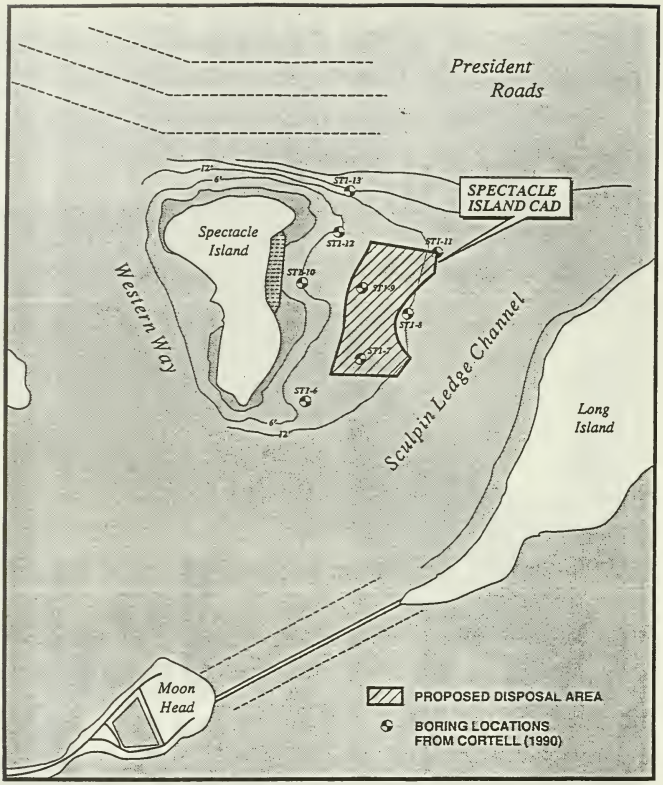
Boston Harbor Dredging Project EIR/S	Figure A1-12. Site map for Cabot Paint site.
N *Scale:* 0 50 100 *Scale in Yards*	*Source:* Boston Harbor Navigation Chart



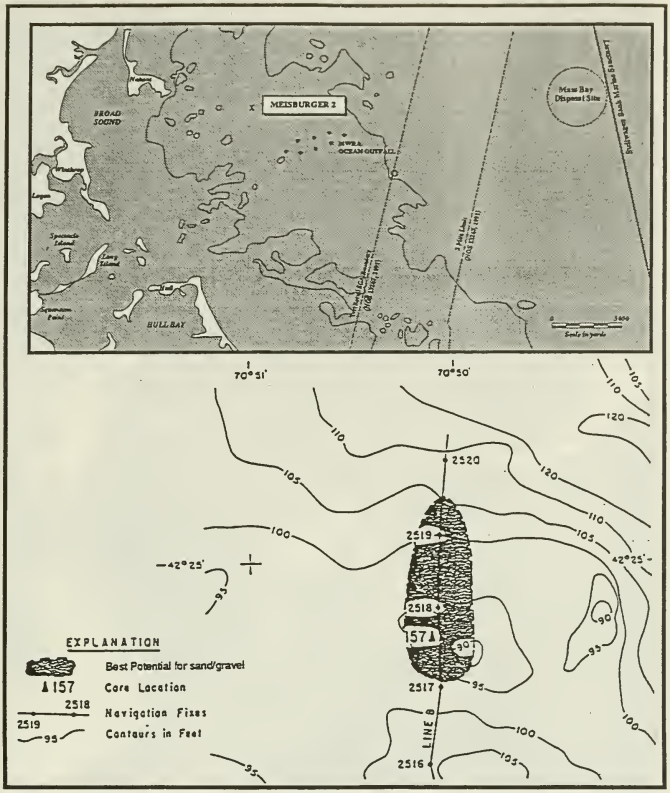
Boston Harbor Dredging Project EIR/S	Figure A1-13.Site map for Little Mystic Channel site.
N Scale: 0 100 200 Scale in Yards	Source: Boston Harbor Navigation Chart



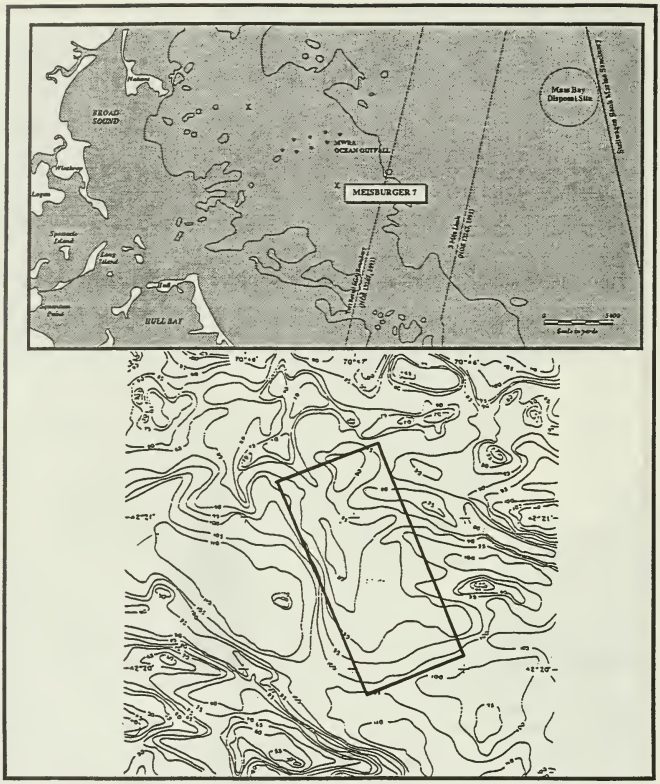
Boston Harbor Dredging Project EIR/S	Figure A1-14. Site map for Reserved Channel site.
N Scale: 0 100 200 Scale in yards	Source: Boston Harbor Navigation Chart



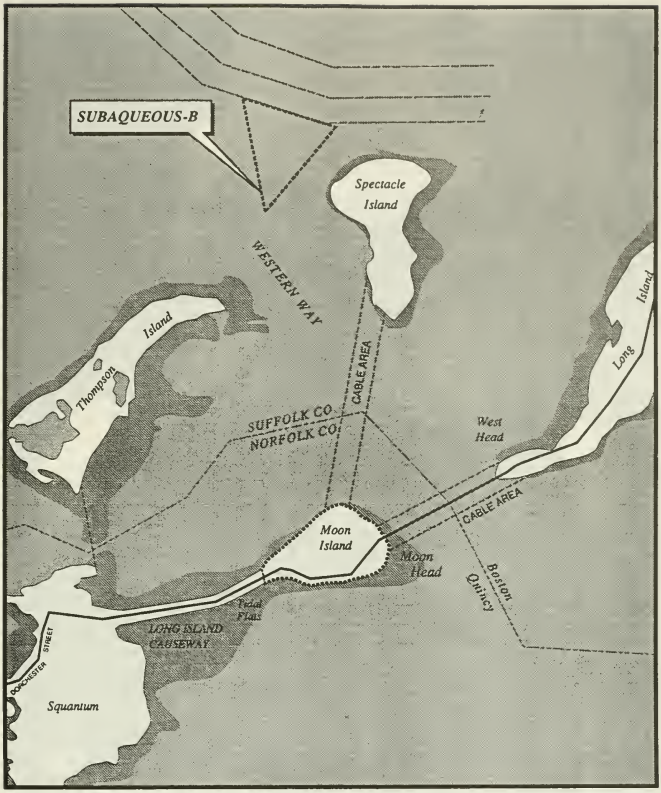
Boston Harbor Dredging Project EIR/S	Figure A1-15. Site map for Spectacle Island CAD site.
N *Scale:* Scale in Yards 500 0 1000	*Source:* NOS Chart No. 13270 Sediment Classifications from Cortell 1990



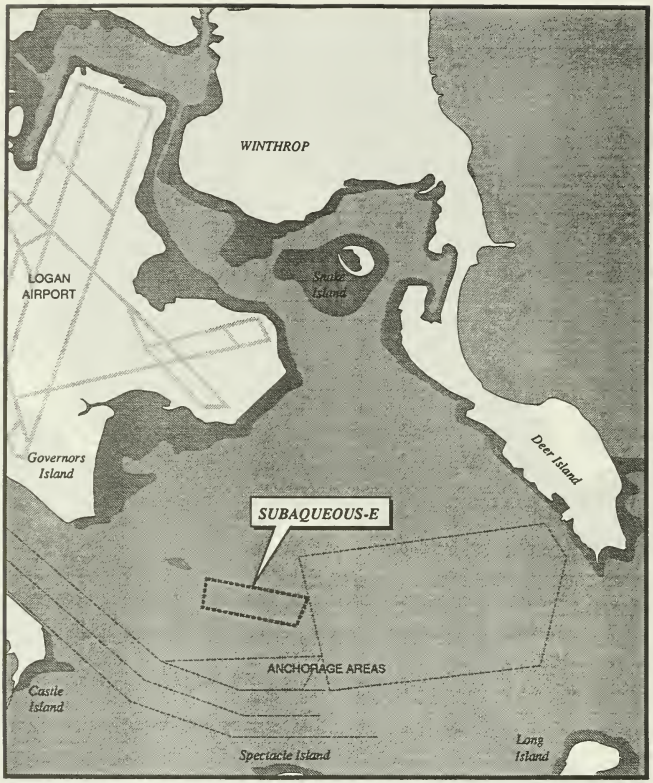
Boston Harbor Dredging Project EIR/S	Figure A1-16. Site map for Meisburger 2 site.
N *Scale:* Scale in Yards 500 0 1000	*Source:* Metcalf & Eddy Inc., 1992



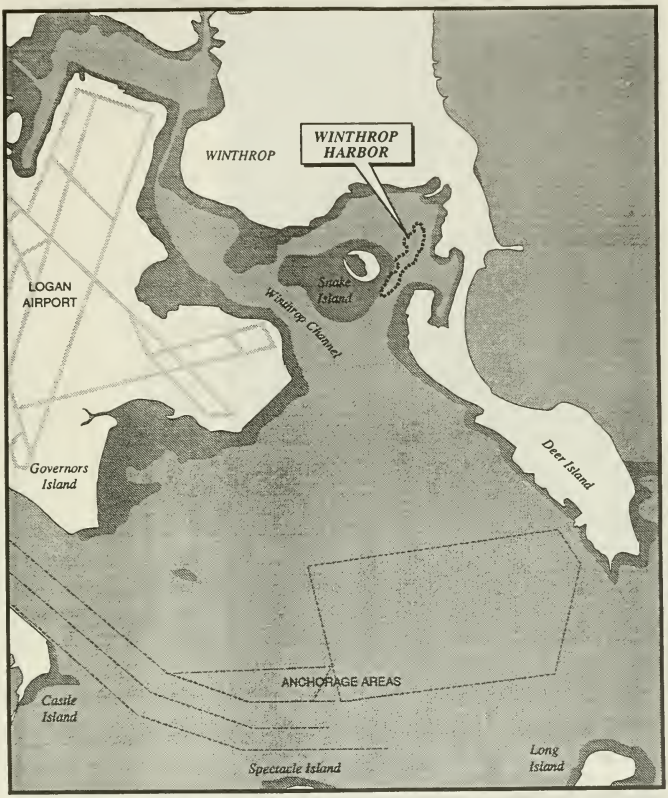
Boston Harbor Dredging Project EIR/S	Figure A1-17. Site map for Meisburger 7 site. * GENERAL AREA WITHIN WHICH DISPOSAL SITE WOULD BE LOCATED.
N *Scale:* Scale in Yards 0 1000 2000	*Source:* Metcalf & Eddy Inc., 1992



Boston Harbor Dredging Project EIR/S	Figure A1-18. Site map for potential disposal site, Subaqueous-B
N Scale: 0 1000 2000 Scale in Feet	Source: Boston Inner Harbor Navigation Chart



Boston Harbor Dredging Project EIR/S	Figure A1-19. Site map for potential disposal site, Subaqueous-E.
N	Scale: 0 400 800 Scale in Yards
	Source: Boston Inner Harbor Navigation Chart



Boston Harbor Dredging Project EIR/S	Figure A1-20. Site map for potential disposal site, Winthrop Harbor.
N	Scale: 0 400 800 Scale in Yards
	Source: Boston Inner Harbor Navigation Chart

MASSACHUSETTS BAY DISPOSAL SITE
BOSTON LIGHTSHIP DISPOSAL AREA (HISTORIC)
* DISPOSAL LOCATION
MWRA OCEAN OUTFALL
BROAD SOUND
HULL BAY
Depositional substrates within the disposal sites.
* BLDS approximate proposed disposal location = 42° 19' 48" N
70° 37' 30" W

Boston Harbor Dredging Project EIR/S	Figure A1-21. Site map for Boston Lightship and MBDS Sites.
N Scale: 0 5000 Scale in yards	Source: Boston Harbor Navigation Chart

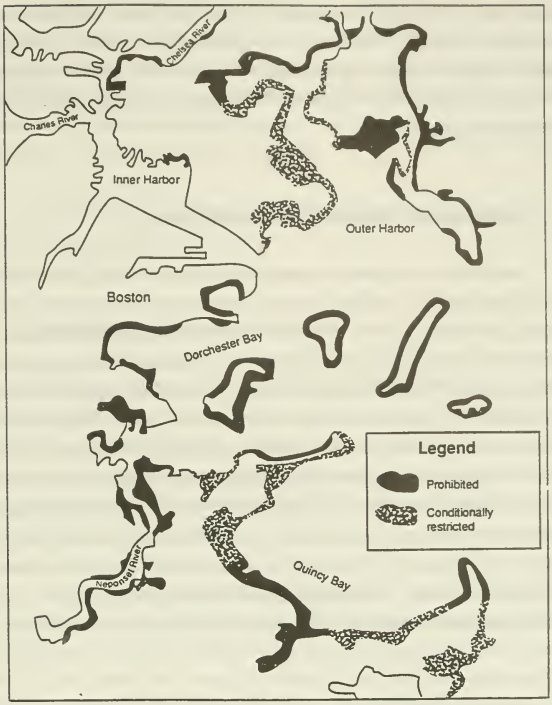


Figure A1-22. Prohibited and restricted clam beds in Boston Harbor. There are many acres of soft-shell clam beds in Boston Harbor, but none are open for unrestricted harvest.

(From MWRA "State of Boston Harbor:1991" report)

and capping with clay would alter this substrate in a way that, without modification (through biological activity or physical forces), would not be attractive to recruitment of benthic fauna immediately. It could eventually recover to support the same benthic infaunal community that exists now. SAIC (1994) identified extensive recolonization of old dredged material with late successional stage organisms.

Indirect Impacts - Short-term Water Quality Effects

Because Boston Lightship is located outside of state waters, use of the federal definition of the mixing zone (compliance with acute water quality criteria outside the boundary of the mixing zone within four hours of each disposal event) is appropriate for this site. For designated open water disposal sites, under Section 103, the established site boundaries mark the edge of the mixing zone. Sediment disposal simulations for the Boston Lightship site conducted with COE's ADDAM'S model showed that four hours after a 2,000 cy disposal event water quality criteria for copper were not exceeded outside the disposal site's boundaries (Table A1-19). Since this was true for the summer (stratified) condition, it would be safe to assume it would hold for winter (unstratified) conditions as well. Within the site, soluble copper concentrations in the water column were also estimated to be below the chronic water quality criterion. After a four hour period, the total volume of silt within the cloud was estimated to be equivalent to about 3.3% of the initial disposal volume. These results indicate that risks to marine resources would be minimal since water quality criteria would be met after two hours within the disposal site.

Indirect Impacts - Long-Term Water Quality/Site Stability

The typical bottom currents at Boston Lightship are about 0.5 ft/sec (15 cm/sec). These currents are sufficient to keep silt in suspension, although too low to erode consolidated silt. The extent of the hard sand substrate (>70% of the stations examined by Sediment Profile Imagery) at Boston Lightship is indicative of the regularity of this current regime. The water depths (about 50 m) and its location outside of normal shipping lanes make it unlikely that the substrate at Boston Lightship would be affected by vessel traffic.

The Boston Lightship area faces an unlimited fetch from winds from all directions except west. The water depth is again beneficial in protecting this site from the wind-wave generated bottom currents. A one-year return storm event is estimated to produce nearbottom currents of 1.6 ft/sec (49 cm/sec), more than sufficient to erode unconsolidated silt or consolidated silt with little clay. Because silts disposed at Boston Lightship would be mounded, they would be more readily eroded than if placed in a depression.

Use of the Boston Lightship site would require interim capping in anticipation of wind or storm events that could disturb the bottom.

Indirect Impacts - Downstream Resources

Biological sampling in the fall of 1994 revealed the presence of a diverse benthic community of moderate abundances. Lobster catches were relatively high (lower than the Meisburger sites, but substantially higher than any Boston Harbor locations). Trawl samples (Table A1-4) were dominated by lobsters (59% of the catch) and winter flounder (28% of the catch). Total catch was similar to that in Boston Harbor, although the relative abundance of lobsters was higher in the offshore catch.

The COE estimates that disposal of silt at Boston Lightship would result in the dispersion of about 5% of the material from the site through water column transport. The water depths indicate that it would take less than 5 hours (less than 0.5 tidal cycles) under nonstratified conditions for this vagrant silt to reach the substrate. The area where vagrant silt from an individual disposal event reached the bottom would vary with the tidal stage, but over the course of the project, the silt could be deposited in a concentric circle around the point of disposal. The unconsolidated nature of the silt would make it highly susceptible to resuspension, therefore, it is unlikely that it would be detectable in future monitoring.

It is this area of silt deposition, however, that could be identified as the downstream area of concern. The benthic community observed in the fall of 1994 was composed of a mixture

of surface and burrowing species. The surface-dwelling species and sessile suspension and surface deposit-feeders would be more susceptible to the effects of smothering than the burrowing species.

Indirect Impacts - Biological Exposure Potential

Water Column Effects

The depth at which Boston Lightship is located provides a large volume of water to dilute dissolved contaminants and suspended sediments following each disposal event. No constituents are expected to reach concentrations in the water column that exceed the chronic water quality criteria. Therefore, the potential for pelagic organisms to be affected by disposal activities is negligible.

Substrate Effects

While the Boston Lightship area has been used for disposal of dredged material and other material in the past, the extent of contamination in the substrate is not well defined. Because all areas examined in fall 1994 were characterized by granular (sandy) or rocky substrate, it is unlikely that contaminants are widespread, although there may be localized pockets in the vicinity of earlier disposal activities. Creation of a mound of silty material from Boston Harbor would create an approximately 100-acre area of elevated concentrations of organic and inorganic contaminants until it was capped. The frequent disposal activity in the area from the BHNIP would continuously disturb the site, likely preventing colonization by any but the most opportunistic species. Absence of food and frequency of disturbance would tend to deter bottom-feeding fish from lingering on the contaminated sediments.

Should sediments accumulate adjacent to the mound, there would be a greater risk of exposure to demersal finfish. Because accumulation could occur without smothering the benthic organisms, food would continue to be available for bottom-feeders. The potential for ingestion and dermal contact would be higher than on the disposal mound itself. However, the ephemeral nature of this siltation would counteract this potential.

Other Issues

Cetaceans may transient the disposal site, but are not likely to be to impacted by ocean disposal. This area is about 9 nautical miles west of the Stellwagen Bank; and thus sufficiently removed from their main area for feeding and congregating so that problems from disposal activities should not occur. Disposal of dredged material at BLDS is not expected to have any substantial adverse impact on endangered species, their prey, or the habitat essential for their survival. Consultation with the NMFS under Section 7 of the Endangered Species Act of 1973 (as amended, 16 U.S.C. 1531 *et seq*), has been initiated to ensure this activity will not jeopardize any endangered or threatened species.

BLDS is in an area deemed "sensitive" by the Board of Underwater Archeological Resources because of the number of shipwrecks that have occurred there over time or because historic disposal sites may contain material of archeological interest. However, discussion with the staff of the Board suggests there may not be resources at the specific disposal site. This will be confirmed by the staff upon review of the Board's files about the proposed sites.

BLDS is an inactive disposal site. Extensive shipping, fishing, recreational activities, and scientific investigations take place in Massachusetts Bay year around. There are no known or anticipated interferences from disposal events at this site except the uncertainty surrounding conditions created by previous disposal of miscellaneous wastes. If these uncertainties can be resolved, the use of the site could provide a solution for the disposal of large amounts of unsuitable material by capping and sequestering the contaminants in the future.

3.0 ENVIRONMENTAL EVALUATION - DREDGING SITES

3.1 OTHER PROJECT CONSIDERATIONS

The majority of the environmental and socio-economic information concerning Boston Harbor, and the areas to be dredged for the navigation improvement project, are discussed in EIR/S Sections 2.0 and 4.0. Therefore, only additional information is covered here.

Besides the navigation improvement project, a 9.5 mile long sewage outfall tunnel is currently being constructed from Deer Island underneath the seafloor into Massachusetts Bay for the MWRA project. Completion of the outfall pipe is expected in 1995. The Third Harbor Tunnel will cross the main ship channel from South Boston to Logan Airport in East Boston. Dredging for the tunnel was completed in 1993. Placement of the tunnel sections for the Third Harbor Tunnel was completed in 1993. In addition, barge traffic will be hauling dredged and excavated materials removed from the Central Artery to Spectacle Island.

Interference between construction of the above two projects and the associated dredging of the navigation improvement project is not expected to occur. Construction of the navigation improvement project is not expected to begin until 1996. No interference with the MWRA project is expected. Barge traffic from this project is expected to be minimal. Potential disposal site locations would not interfere with the construction of the outfall tunnel.

Deepening the Federal channels may involve relocating buried utilities. The deepening in the Chelsea River was limited due to the expense involved with relocating the gas siphon. Utilities that were identified include a powerline running generally down the center of the Reserved Channel, telephone cable across the Inner Confluence, a water tunnel, electrical cable and bridge cables across the lower Chelsea River and two water tunnels, a sewer siphon, a gas siphon, electrical cable and fire alarm cable across the upper Chelsea River. Table A1-20 lists the known utilities and expected depths.

In most cases, the utilities will be relocated by burying them deeper under the channel. The gas siphon is a special case and will have a protective layer of rip-rap placed over the line rather than actually relocating the siphon.

The deepening of three harbor tributaries will require particular care to avoid damaging utilities crossings. During November 1992 field data were collected using side scan sonar and an array of geophysical instruments which enhanced existing knowledge of buried utilities. While the information obtained does not precisely locate the depth of utilities, it does show either the trench or changes in bottom material densities indicating existence of trench excavation and fill. This information has not been published yet, but some data are currently available.

The berthing areas and bulkheads adjacent to the navigation channels will be investigated to ensure that dredging a deeper channel will not undermine the integrity of the bulkheads. Surveys conducted to date have not revealed evidence of this type of problem.

3.2 DREDGING AREAS - ENVIRONMENTAL RESOURCES

3.2.1 Water Quality

The dominant currents in the harbor are tidal in origin, although wind driven currents occur during storms. Freshwater discharges from the Mystic, Charles, and Chelsea Rivers generally overlie the more dense seawater flows from the tides. Freshwater flows average 350 to 500 cubic feet per second (CFS) in the summer. Tidal input is several orders of magnitude greater than freshwater input. Tidal flows average 320,000 cubic foot per second (CFS) for a six hour period with volumes ranging from 10.6 billion gallons at low tide to 179.9 billion gallons at high tide (Metcalf and Eddy, 1976, and MDWPC, 1986). Approximately 73.3 billion gallons are exchanged through three channels linked with the President Roads area and one channel linked with Nantasket Roads. In addition, 265 million gallons per day of waste water is released into the Harbor system from the Boston regional wastewater treatment plant on Deer Island.

The average tidal range in Boston Harbor is 9.5 feet with spring tidal ranges often in excess of 11 feet. Average current velocities for the Inner Harbor are less than 0.5 knots. Tidal

currents in other portions of the Harbor vary greatly in speed because of the irregular bottom topography and the large number of islands (Knebel, et.al., 1991). In general, maximum near-bottom current speeds are greatest (> 10 knots) in constricted channels and depressions, are intermediate (3-6 knots) at locations sheltered by islands and points of land, and are weakest (< 3 knots) over the shallow subtidal flats (Bumpus, et.al., 1951; U.S. Coast and Geodetic Survey, 1953; Mencher, et al, 1968; National Ocean Survey, 1977; Signell and Butman, 1990 in Knebel, et.al., 1991). Maximum current velocities during spring tide in the areas to be dredged are as follows: 0.1 knots in the Mystic River, 0.2 knots in the Chelsea Rivers and 0.7 knots in the Main Ship Channel vicinity (N.O.A.A., 1986).

The quality of water in Boston Harbor has been the target of considerable expenditures of Federal, State and private funds. For the most part, raw sewage and untreated industrial discharges are being rectified by the Massachusetts Water Resources Authority (MWRA) under a court order aimed at cleaning-up Boston Harbor. A new primary sewage treatment plant is currently under construction on Deer Island, including relocation of the ocean outfall from the island to nine miles offshore. The construction of the first battery of secondary treatment upgrades is to begin shortly. Disposal of sewage sludge into Boston Harbor ceased in 1992. This has resulted in a rapid and measurable increase in water quality (MWRA, 1993). Water quality is expected to improve further when the secondary treatment facility on Deer Island is in full operation in the year 2000 (MWRA, 1993). The history of contamination from these and other sources in Boston Harbor can be found in the harbor sediments.

Water quality in Boston Harbor has been found to vary both spatially and temporally. The Feasibility Study provided a general seasonal summary of previously available data. A more recent data set for June through October 1985 (MDWPC, 1986 and New England Aquarium, 1990) is also within the ranges listed on this summary.

Barring localized effects around thermal outfalls from power generating stations, the temperature regime in the Harbor is under normal climatic and estuarine controls. The enrichment level in the outer harbor is generally considered to be at a mesotrophic scale without excessive primary production (National Commission on Water Quality, 1976). The inner harbor is also enriched from combined sewer outflows and the high level of nutrients in the river system feeding the harbor.

Vertically averaged dissolved oxygen levels (MDWPC, 1986) exhibit values ranging as low as 4.5 ppm in the project area. These values represent summer biological activity in conjunction with organic enrichment of the ecosystem. Oxygen depletion is a substantial problem in many estuaries during times of thermal stratification of the water column. The strengthening and deepening of the water column thermocline limits the circulation and oxygen exchange in the nearbottom waters. As temperatures peak (often in August), available dissolved oxygen levels decrease and cause a corresponding depression in biological activity at the sediment water interface. This "August Effect", as it is commonly referenced, is a major environmental factor in structuring biological communities in the project area.

The Massachusetts Water Resources Authority (MWRA) and the New England Aquarium have measured dissolved oxygen throughout Boston Harbor. MWRA (1992) measurements of bottom waters in the Inner Harbor frequently show DO below the standard 5.0 mg/l, with occasional measurements below 2 mg/l. Low oxygen conditions are much rarer in surface waters, and tend to occur in restricted channels with high combined sewer overflows (CSO) input, such as Fort Point Channel and the Reserved Channel (MWRA, 1992). Dissolved oxygen in the Outer Harbor and Dorchester Bay measured by MWRA and the Aquarium monitoring programs are nearly always above the 5 mg/l standard for Class SB waters. The water chemistry of the project area, in particular the organic load and its subsequent chemical oxygen demand, is a substantial factor in the ecology of Boston Harbor.

Salinity data indicate the Outer Harbor is well mixed, while the various regions of the inner harbor are under the influence of freshwater inputs. Essentially, the mouth of the Harbor is considered stenohaline and the Inner and Outer Harbor areas are euryhaline. Oil pollution has created problems in many harbor areas and a permanent oil boom is maintained at the mouth of Chelsea Creek to protect the remainder of the Harbor from potential spills in the main tanker terminal areas.

Coliform bacteria counts have been collected by several agencies for several decades. Bacterial counts have decreased 10 to 100-fold over the past 50 years in the Inner Harbor, near Deer Island, Nut Island, Governors Island, President Roads, Nantasket Roads, Moon Head, and Dorchester Bay (MWRA, 1992). These improvements are related to the construction of treatment plants. Bacterial counts in the Inner Harbor were lower in the 1980s compared to the 1960s. The

extreme violations of fecal coliform water quality measured near Deer Island by the New England Aquarium have not been found since 1988, and water quality near Nut Island has been good since 1987. This improvement in offshore bacterial water quality has been associated with more reliable chlorination of the wastewater treatment plants (MWRA, 1992).

Water quality in the Outer Harbor varies greatly. In 1989 and 1990, MWRA sampling showed that Carson Beach, Pleasure Bay and Northern Dorchester Bay generally met water quality standards. Samples taken near Calf Island in the outer harbor were all within swimming standards. Southern Dorchester Bay, at the mouth of the Neponset River, generally showed poorer water quality. This area is affected by the Neponset River, storm drains outflow, CSOs and possibly sludge. Samples collected at Dorchester Bay beaches in 1991 by MDC indicate a decrease in the number of postings at the two beaches in Southern Dorchester Bay: Tenaean and Malibu. The decrease in postings at these areas can probably be attributed to the operation of new disinfection facilities at Fox Point and Commercial Point sewer outfalls.

In Boston Harbor productive clam beds cover about 4,700 acres (Figure A1-22) (MWRA 1992). None of these beds are open for recreational clamming because sewage indicator bacteria counts are too high (MWRA, 1992). About 2,900 acres of clam beds are restricted to harvesting only by "Master Diggers". These licensed diggers must take all clams harvested to a depuration facility, where the shellfish are held in clean water for two days to cleanse themselves of bacteria.

The Massachusetts Division of Marine Fisheries monitors shellfish growing water as well as the clams themselves for bacteriological safety. Some areas of Boston Harbor, especially in Quincy Bay and Hingham Bay, are often conditionally opened, while other areas, like Dorchester Bay, are virtually never open (MWRA, 1992). Clam beds in the Inner Harbor are prohibited from harvest.

Levels of trace metals in the inner harbor have been related to the sewage discharges, CSOs, urban runoff, and the metals contributed by the major rivers. In the Outer Harbor, higher levels of metals have been found around the sewage outfalls. The U.S. Environmental Protection Agency has developed water quality criteria designed to protect aquatic organisms from the adverse effects of environmental contaminants. Boston Harbor generally meets the water quality

criteria for toxic contaminants (MWRA, 1992). There has been a four-fold decrease in the amount of metals discharged to the Harbor by the MWRA between 1981 and 1991. Results of bioaccumulation studies conducted by MWRA (1992) in 1991 and other studies indicate or suggest that improvements in MWRA discharges are being reflected in improvements in water quality. Although the quality of discharge from MWRA treatment plants is improving, and is expected to improve, various levels and types of contaminants are still released into the aquatic system. These discharges combined with riverine and direct urban runoff represent a degradation of the Boston Harbor water quality.

3.2.2 Sediment Characteristics

General Site Environment

The United States Geological Survey (USGS) currently is conducting studies in Boston Harbor, Massachusetts Bay and Cape Cod Bay to define the geological framework of the region and to understand the transport and accumulation of sediments (Butman, et.al., 1992). One of the goals of the USGS study is to develop a sediment data base. The levels of contaminants vary throughout the Harbor predominantly depending on hydrology and substrate type. In general, metal and organic levels are relatively high in the Inner Harbor and decrease seaward. The surficial sediments represent fine grained material with associated chemicals deposited since the area was last maintained. The results of the chemical sampling reflect the normal sedimentological trends of increased chemical levels with those substrates of higher total organic carbon and silt-clay content (Boehm et al. 1984). The Mystic River (sampling stations A and B) exhibited the highest contaminant levels and was also the most recently dredged. The material accumulated at these stations represents the highest levels in the harbor, apparently derived from the Mystic River drainage area. In contrast, the least contaminated material in the harbor is also found in the Mystic River at Station C. This station is typical of the pristine lean clay layer of the deeper sediments without deposition of a recent silt/clay overburden.

An acoustic impedance survey of the Federal channels to be dredged was performed by ACOE in November 1992. This survey was conducted to locate and determine the amount of silt (maintenance layer), clay, and rock. This survey was also used to assist in locating utilities.

The surface sediments in the federal channels and the berth areas are subject to resuspension during virtually every ship passage. Appendix G presents an estimate of the bottom velocities that are generated by the various types of cargo vessels and tugs that operate in Boston Harbor. Silt, the predominant grain-size of the surface sediments, can be resuspended by currents as slow as 0.2 m/s. Bottom velocities generated by cargo vessels passing at slow speeds through the harbor (according to the traffic patterns described in the Shiphandling Simulation Study provided in the DEIR/S) can exceed this value up to 400 m astern of the vessel. Tugs can generate bottom velocities above this value up to 200 m astern. These velocities dissipate rapidly as the vessels traverse the channel. Sediments resuspended by these currents settle back to the substrate after being transported relatively short distances. Turning areas are particularly susceptible to this influence. Portions of the confluence of the Mystic River, Chelsea River and Main Ship Channel showed evidence of scour in the acoustic impedance study; parent material is exposed in these areas.

Upland Disposal Testing

The Massachusetts Department of Environmental Protection requires information on additional parameters (total petroleum hydrocarbons) and toxic characteristic leaching procedure (TCLP) in order to evaluate the suitability of dredged material for upland disposal. Chemical testing was also performed for sodium and chlorides at the request of the interagency work group members and because both sodium and chloride can have an impact on ground water if the sediment is disposed of upland and leaching occurs (at unlined sites).

The averages for total petroleum hydrocarbon (TPH) concentrations and Total Organic Carbon (TOC) for all sites tested are presented in Table A1-21. The highest average concentrations of TPH was found at the Mystic Pier 1 site and the lowest average concentration of TPH was found at the Conley 11-13 site. The highest average concentration of TOC occurred at Edison Barge Intake and Edison Barge Berth (13.0% and 10.2% respectively) and the lowest average concentration of TOC occurred at the Gulf Oil site (1.7%).

Toxic Characteristic Leaching Procedure (TCLP)

If the bulk chemical concentration in the sediment tested equaled or exceeded the Massachusetts Department of Environment bulk soil concentration for TCLP analysis, then there is a mathematical chance that the TCLP test could exceed threshold limits. In order to know if the parameter of interest would exceed the EPA regulatory limit, a TCLP test must be performed in order to verify if the sediment has hazardous characteristics. Only chromium and lead exceeded the mathematical thresholds for requiring TCLP analysis. Table A1-22 is a summary of the Massachusetts DEP Bulk Soil Concentration limits along with the lead and chromium bulk and TCLP concentrations in relation to the regulatory limits. In all cases the TCLP results were orders of magnitude below the regulatory levels. Therefore, none of the sediments to be dredged in Boston Harbor show hazardous characteristics.

Table A1-23 shows the concentration of sodium and chloride found at each site tested. The highest concentration of sodium occurred at Eastern Minerals (40140 mg/kg) and the Mystic Piers had the highest percent of chloride (2.0%).

3.2.3 Biological Resources

In July and November 1986 benthic biological sampling was conducted at thirteen (13) stations in the proposed dredging area. Finfish samples and water column parameters were also obtained at various locations. In general, the benthic population in Boston Harbor is described below, based on results from thirteen (13) stations randomly located throughout the project area and sampled in two seasons. The sampling program used a 0.04m Van Veen grab and screened samples through a 0.5mm sieve. Additional details can be found in the 1988 Environmental Assessment.

All three tributaries of the Boston Harbor navigation improvement project contained on average a high number of organisms per square meter (4,798; S.D. = 8623.2) in July. The average number of species recovered in July was eight (S.D. = 8.4). The dominant organisms

were the polychaetes *Capitella capitata* (54.8 %, S.D. = 28.3); *Polydora ligni* (15.3%, S.D. = 7.1); and *Polydora aggregata* (12.3%, S.D. = 11.7).

The Inner Harbor rivers and the Reserved Channel undergo remarkable reductions in densities between seasons. Theoretically, a population can rebound from nearly an azoic state (induced by low dissolved oxygen levels) through adult recruitment. Between July and November, a statistically significant ($p < 0.005$) reduction in benthic population densities and diversity occurred. The November population contained on average a much lower number (29; S.D. = 71.5) of organisms per square meter and number of species (0.4; S.D. = 0.7). The dominant organisms were the polychaetes *Polydora ligni* (20.0%; S.D. = 11.5); *Streblospio benedicti* (17.9%, S.D. = 16.8); the sand shrimp *Crangon septemspinosa* (11.0%, S.D. = 19.0); and the amphipod crustacean *Ampelisca abdita* (6.7%, S.D. = 11.5).

This tremendous reduction in benthic productivity is not uncommon in urban estuaries where the cumulative effects of high organic load, vessel wakes, increasing water temperature, reduced wind mixing, and increased water column stratification combine with microbial activities that peak in late summer to reduce dissolved oxygen levels. The dissolved oxygen stress is often severe enough to eliminate non-motile benthic populations -- the so-called "August effect".

Given the cyclic (annual) nature of low dissolved oxygen levels in Boston Harbor, the benthic inhabitants are well adjusted to colonizing and recolonizing azoic substrates annually. This type of pioneering species assemblage can be expected quickly to recolonize a dredged area with minimal disruption in benthic productivity.

The polychaetes *Capitella capitata* and *Streblospio benedicti* are the dominant benthic organisms present in the project area. Both of these species are tolerant of physical and chemical stresses that are characteristic of urban harbors such as Boston. Each of these species are "r - strategists," i.e. species whose life history is characterized by small body size, short generation times and high reproduction (r) rate (Grassle and Grassle, 1984). *Capitella capitata* has shown generation times as short as three weeks (Tenore and Chesney, 1985). These life history attributes allow the proliferation of this species within the project area on a cyclic basis. High densities of *Capitella capitata* were found in July but not in November. This cycle of proliferation and die-

off keeps the benthic population in a state of dynamic equilibrium. Project areas which were azoic in both sampling periods may have a sufficient additional stress of sulphidic or petroleum compounds accumulating in the substrate so that it is intolerable to even these species (James and Gibson, 1980). This cycle of recolonization by the benthos can be expected to allow rapid biogenic reworking and recolonization of the newly exposed clay layers in the post dredging phase.

The soft shelled clam *Mya arenaria* is the most common commercial shellfish within the Boston Harbor area (Figure A1-22). Blue mussels *Mytilus edulis* and duck clams *Macoma balthica* are also found in shellfish beds but are not harvested. Densities of shellfish beds have been documented by Jerome et al. (1966), Chesmore et al, (1971) and Iwanowicz et al. (1973) and these data can be referred to for detailed information.

As described in the previous section, waters overlying the shellfish beds are contaminated by wastes from sewage outfalls, resulting in the presence of coliform bacteria in the shellfish. The beds are under the jurisdiction of Massachusetts Department of Environmental Protection and are closed to commercial and noncommercial harvesting, except by Master Diggers who must have the clams depurated at a purification plant.

Most of the productive soft shelled clam beds near the proposed dredging project are closed except for restricted areas near Logan Airport and a seasonal area in Pleasure Bay, the latter located immediately southwest of Castle Island. Logan Airport beds are one nautical mile north of President Roads and the beds at Pleasure Island are about two nautical miles west of President Roads. Shellfish beds open to Master Diggers are predominantly within the lower bays and are distant from the shipping channels and project areas.

The limited amount of lobstering within the Boston area takes place primarily in Quincy, Dorchester, and Hingham Bays. Lobstering is minimal or nonexistent in the areas to be primarily affected by the proposed work.

Fisheries resources of the Inner and Outer Harbors have been inventoried by previous studies. These studies include the MES (1972, 1972 a, b, c; 1973; 1976 a, b; 1977 a, b) and

Haedrich and Haedrich (1974) studies which developed information in the Lower Mystic River. Data in the Outer Harbor were developed by Jerome et al. (1966), Chesmore et al. (1971) and Iwanowicz et al. (1973).

The studies on the lower Mystic River were concentrated in the area between Amelia Earhart Dam and the Mystic River (Tobin) Bridge. Haedrich and Haedrich (1974) found that the seasonal species composition was similar to other northeast harbor communities. Winter flounder, smelt and alewives are found in the river throughout the year and are, therefore, considered residents. Ocean pout and blueback herring are summer residents, whereas sea herring is considered a winter resident. With the exception of ocean pout, these residents were identified in the 1986 NED biological sampling effort.

In fall 1994 finfish were sampled in the Mystic River, Chelsea River and Inner Confluence using an otter trawl. Results are presented in Table A1-4. Winter flounder was the most abundant species collected in each area.

Finfish sampling identified anadromous finfish, resident finfish and lobster as occurring in the project area. In a recent report by the National Oceanic and Atmospheric Administration (N.O.A.A. 1984), anadromous finfish species were identified as being of special concern in the project area.

Information on spawning species, numbers and quality of spawn and their significance to regional resources is imprecise and sketchy. Since the principal streams discharging into the Inner Harbor rivers have dams located on them, tidal spawns of smelt and alewives are unlikely. In addition, it is not known if winter flounder use Boston's Inner Harbor for spawning as well as an area of local feeding. From the habits of these fish and from their behavior in the Mystic River channel area, they appear to stay in particular resident areas within the Inner and Outer harbors. Larval contribution to the eventual recruitment of these fish in other areas is not known.

In summary, a spring/summer movement of anadromous finfish occurs through the project area as they move into spawning (freshwater) tributaries. Lobsters and flounder are generally in the Outer Harbor (areas of high productivity) preferring cool waters. In summer, as water temperatures rise, productivity in benthic habitats sharply decline in response to low

dissolved oxygen in the near bottom water column, restricting fauna to the Outer Harbor (Main Ship Channel) areas. By fall, the Inner Harbor has juvenile flounder feeding on sand shrimp while waters are cooling toward winter spawning temperatures. In winter, finfish, except for the cold water spawning flounder, and lobster move offshore as harbor water temperatures decrease. This fall/winter water cooling allows a balance of the oxygen depletion that occurred in the warmer seasons. High organic load freshwater inputs and warming water temperatures initiate the complex cycle in the spring.

Offshore and longshore areas of the Harbor were trawled for finfish in the studies done by the Massachusetts Division of Marine Fisheries. Atlantic silverside, mummichog and Atlantic tomcod were the predominant species found in the longshore trawls. Some of the offshore sampling sites yielded high densities of winter flounder, Atlantic tomcod, fourspine stickleback, and rainbow smelt. The highest densities of finfish were taken during the months of September and October, with Atlantic silverside and winter flounder the predominant species. The densities of finfish dropped during the winter months of December through March as the fish moved offshore to winter feeding grounds.

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TABLE A1-1. LANDFILL CHARACTERISTICS

	PLAINVILLE	FITCHBURG/ WESTMINISTER	E. BRIDGEWATER
DAILY CAPACITY			
Total Waste Capacity	850-925 cy/day	350 cy/day	1075 cy/day
Available Waste Capacity[1]	150-200 cy/day	200 cy/day	75 cy/day
Cover Capacity	500 cy/day	250 cy/day	400 cy/day
Available Cover Capacity	100 cy/day	Unknown	Variable
ANNUAL TOTAL CAPACITY	350,000 cy/yr	100,000 cy/yr	250,000 cy/yr
STOCKPILING CAPACITY[2]		200,000 cy	8,000-10,000 cy
WASTE MATERIAL LIMITATIONS			
Dewatering	No free standing water	No free standing water	No free standing water
Solids	≥40% solids	≥25% solids	≥20% solids
Odor	Deodorizing suggested	Must have no odor	If odor, BFI will lime
COVER MATERIAL LIMITATIONS	Must meet DEP standards for TCLP[3], pH, solids, reactivity, ignitability.	Must meet 310 CMR 19 regulations.	Must meet DEP standards for TCLP, PCBs, reactivity, corrosivity, free liquid, solids. Odor must be inoffensive to community. No large boulders.
ESTIMATED CLOSURE DATE	1995, but proposed expansions would extend until 2000.	1997	1996
TOWN/BOARD OF HEALTH REQUIREMENTS	Verbal coordination needed	Coordination with 2 local boards	Coordination needed

(Continued)

TABLE A1-1. (CONTINUED).

	PLAINVILLE	FITCHBURG/ WESTMINISTER	E. BRIDGEWATER
SPECIAL WASTE RECEIVED IN PAST	Waste water treatment plant grit and screenings	Wastewater treatment plant sludge.	Sewage sludge, petroleum contaminated soil.
TRUCKING LIMITATIONS			
Number/day	No limitations	No limitations	No limitations
Operating hours	7 AM - 3 PM	7 AM - 3 PM	7 AM - 3 PM
TIPPING FEE[4]	$56/cy	$70/cy	$28/cy
DISTANCE TO SITE	35 mi.	45 mi.	25 mi.

[1]Capacity available for project dredged material.
[2]Unlined cover material can be stockpiled.
[3]Toxic Characteristic Leaching Procedure. An EPA-derived test for hazardous characteristics.
[4]Approximate costs assuming an average ratio of 1.4 tons/cy; actual tipping fees are based on weight.

TABLE A1-2. ESTIMATED ABUNDANCE (NO./m^2) OF BENTHIC INFAUNA (RETAINED ON A 0.5 mm MESH SIEVE) COLLECTED BY 0.023 m^2 PONAR GRAB FROM PROPOSED DISPOSAL SITES IN BOSTON HARBOR, APRIL 28-29, 1993.

	STATION															
TAXA	MP-1	MP-3	RB-1	RB-3	RB-5	AM-1	AM-3	CP-1	CP-3	LMC-1	LMC-2	LMC-3	LMC-4	RC-1	RC-2	RC-3	RC-4
Oligochaeta	45	817	475	172	172	559		1806	86		13717	258	86	2451	15480		26574
Asabellides oculata							43										
Capitella capitata		4171	2838	2967		213		43			1092				645		1677
Thanyx acutus					688				43	86	387		43				
Cirratulidae											258						
Cirratulides hyperboreus								43			43						
Dodecaceria sp.		43															
Exogone sp.											86						
E. heterosetosa											86						
E. longa																	
Fabricia sabella		172	129								43						215
Polynoidae			172								43	43			43		
Lagisca extenuata			45												43		
Hesionidae															43		
Leitoscoloplos robustus														86	172		
Ninoe nigripalmata			473					215							129		
Nereis aberrans														43			172
Nereis diversicolor								43							172		
Orbiniidae														258	215	43	
Paraonides heterieuxi																	
Phoxocephalus holbolli											43						
Polycirrus sp.															172		
Polydora sp.											43						
P. caeca		258									731						
P. cornuta		86	43	43		2107		301	86		559	215			1419	43	129
Pygospio elegans																	

(Continued)

TABLE A1-2. (CONTINUED)

TAXA	STATION															
	MP-1	MP-2	RS-1	RS-2	RS-3	AM-1	AM-2	CP-1	CP-2	LMC-1	LMC-2	LMC-3	LMC-4	RC-1	RC-2	RC-3	RC-4
Spio cf. limicola															43		
S. thulini											86						
Spiophanes bombyx											43						
Streblospio benedicti					86	301	301	4902	1548	43	2709	2021	129		1548	215	
Chironomidae				43													
Collembola				43													
Ampelisca abdita														43			
Balanus crenatus											43						
Corvunus maenas			43														
Caprophium sp.											86				43		215
C. acherusicum			43														
C. ussuiviense											1333				43		2580
Crangon septemspinosa							43						43				
Diastylis sculpta																	
Dyspeches sp.												43					
Harpacticoida			86				43										
Hiatidentatapus sp.											258						
H. gryllotalpa			172			86		43			2323		43		688		1505
Ostracoda	43																
Pagurus longicarpus						43											
Sembalanus balanoides		43															
Crepidula sp.															43		
C. formicata											86				129		
C. plana						43					43						
Navarrus irritatus												43					
Unatella sp.		D															

(Continued)

TABLE A1-2. (CONTINUED)

TAXA	STATION															
	MP-1	MP-2	RS-1	RS-2	RS-3	AM-1	AM-2	CP-1	CP-2	LMC-1	LMC-2	LMC-3	LMC-4	RC-1	RC-2	RC-3	RC-4
Littorina littorea											129						
Mya arenaria		D									43			86			43
Mytilidae		D	D	D													
Tellina agilis															86		
Ciona intestinalis		86										43					
Athecata												P					
Obelia dichotoma			P														
Nemertinea			43														86
Nematoda		11,934	236,672	17,329	215	9,933		1,806	1,591		2,838	13,932	2,752	129			16,641
Ascidian		43															
Molgula sp.		43															
Polysiphonia fibrosa		43															
Total Abundance (no./m^2)	86	17,739	241,230	20,597	1,161	18,287	430	9,202	3,354	129	27,907	16,598	3,096	3,096	21,156	301	49,837
Total No. Discrete Taxa[a]	2	11	13	6	4	8	4	9	5	2	22	8	6	7	14	4	10
% Polychaeta	0	27	2	15	67	20	80	59	50	100	25	14	5	13	22	88	4
% Crustacea	0	1	<1	<1	0	1	10	2	0	0	15	1	11	1	4	13	9
% Bivalvia	0	0	0	0	0	0	0	0	0	0	0	0	0	3	<1	0	<1

P = present but not enumerable; D = dead individuals present; counts represent live animals only
[a]Higher phylogenetic categories (e.g. family, genus) were not included in total no. of discrete taxa when lower phylogenetic categories were present.

TABLE A1-3. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM INNER HARBOR LOCATIONS, OCTOBER 1994.

GROUP	SPECIES	AMSTAR	CHEL 01	CHEL 02	CHELSEA CREEK	CONLEY	CABOT POINT		EVERETT	REVERE SUGAR
		HABITAT	HABITAT	HABITAT	HABITAT	HABITAT	HABITAT		HABITAT	HABITAT
		III	III	III	II	III	II	III	III	III
NO. OF SAMPLES	TOTAL	2.0	2.0	2.0	5.0	1.0	1.0	1.0	2.0	3.0
PORIFERA	HALICHONDRIA PANICEA				P					
HYDROZOA	CLYTIA GRACILIS									
	OBELIA DICHOTOMA					P				
	OBELIA SP.									
NEMATODA	NEMATODA	587.5	87.5	25.0	25.0	450.0			25.0	66.7
POLYCHAETA	AMAITIDES SP.				5.0					
	ARICIDEA (ACNIRA)									
	CATHERIMAE					25.0				
	CAPITELLA CAPITATA	50.0				75.0				
	CIRRATULIDAE				10.0					108.3
	ETEONE LONGA				5.0					
	GLYCERA DIBRANCHIATA									
	MEDISTE DIVERSICOLOR								12.5	
	LEITOSCOLOPLOS ACUTUS									
	LEITOSCOLOPLOS ROBUSTUS									
	LEITOSCOLOPLOS SP.									
	MALDANIDAE									
	NAREDZELLERIA VIRIDIS									
	NEDIOMASTUS CALIFORNIENSIS					25.0				
	NICROPHTHALMUS ABERRANS									
	NEANTHES SUCCINEA							25.0		
	NEANTHES VIRENS				15.0	25.0			37.5	0.3
	NEPHTYIDAE					25.0				
	NEPHTYS CAECA				10.0					
	NEPHTYS CILIATA				5.0				25.0	
	NEPHTYS INCISA					25.0				
	NEREIDAE									
	NINOE NIGRIPES									
	PARAONAITIS SPECIOSA				5.0					
	PECTINARIA GOULDII	12.5	12.5							
	PECTINARIIDAE	12.5								
	POLYCIRRUS SP.				5.0					
	POLYDORA CORNUTA	625.0	12.5		230.0	25.0	25.0	175.0	37.5	25.0
	POLYDORA SOCIALIS				10.0					
	SPIO FILICORNIS									
	STREBLOSPIO BENEDICTI	412.5	50.0		25.0	50.0		75.0	150.0	50.0
	TharyX ACUTUS		25.0		35.0	50.0		25.0		25.0
OLIGOCHAETA	OLIGOCHAETA	87.5			5.0	200.0		50.0	25.0	183.3
GASTROPODA	CREPIDULA FORNICATA				30.0					
	CREPIDULA PLANA				50.0					
	CREPIDULA SP.				10.0					
	LACUNA VINCTA									
	NASSARIUS TRIVITTATUS		25.0		5.0	25.0				

TABLE A1-3. (Continued)

GROUP	SPECIES	AMSTAR	CHEL 01	CHEL 02	CHELSEA CREEK	CONLEY	CABOT POINT		EVERETT	REVERE SUGAR
		HABITAT	HABITAT	HABITAT	HABITAT	HABITAT	HABITAT		HABITAT	HABITAT
		III	III	III	II	III	II	III	III	III
BIVALVIA	AMONIA SP.									
	BIVALVIA				5.0					
	CERASTODERMA PINNULATUM									
	MIATELLA SP.									
	LYONSIA HYALINA									
	MACOMA BALTHICA								12.5	
	MULINIA LATERALIS			12.5					25.0	
	MYA ARENARIA									
	MYTILIDAE		25.0		5.0					
	TELLINA AGILIS				5.0	25.0				
	TURTONIA MINUTA				5.0					
CIRRIPEDIA	BALANUS CRENATUS									
MYSIDACEA	METERONYSIS FORMOSA									
AMPHIPODA	AMPELISCA ABDITA				30.0	125.0		25.0		
	COROPHIUM BONELLI	50.0								
	GAMMARUS LAWRENCIANUS									8.3
	MICRODEUTOPUS GRYLLOTALPA	37.5								
	PONTOGENEIA INERMIS									
	UNICIOLA INERMIS	12.5								
DECAPODA	CRANGON SEPTEMSPINOSA		37.5		10.0					8.3
BRYOZOA	BUGULA TURRITA				P	P				
OPHIUROIDEA	OPHIUROIDEA								12.5	
ASCIDIACEA	ASCIDIA SP.	25.0								
X NO. OF INDIV	TOTAL	1912.5	275.0	37.5	545.0	1150.0	25.0	575.0	362.5	483.2
X PORIFERA	TOTAL				P					
X HYDROZOA	TOTAL					P				
X NEMATODA	TOTAL	587.5	87.5	25.0	25.0	450.0			25.0	66.7
X POLYCHAETA	TOTAL	1112.5	100.0		360.0	325.0	25.0	300.0	262.5	216.6
X OLIGOCHAETA	TOTAL	87.5			5.0	200.0		50.0	25.0	183.3
X GASTROPODA	TOTAL		25.0		95.0	25.0				
X BIVALVIA	TOTAL		25.0	12.5	20.0	25.0			37.5	
X CIRRIPEDIA	TOTAL									
X MYSIDACEA	TOTAL									
X AMPHIPODA	TOTAL	100.0			30.0	125.0		25.0		8.3
X DECAPODA	TOTAL		37.5		10.0					8.3
X BRYOZOA	TOTAL				P	P				
X OPHIUROIDEA	TOTAL								12.5	
X ASCIDIACEA	TOTAL	25.0								
NO. OF TAXA	TOTAL	11.0	8.0	2.0	26.0	16.0	1.0	6.0	10.0	9.0

TABLE A1-3. (Continued)

GROUP	SPECIES	INNER CONFLUENCE		LITTLE MYSTIC-CHANNEL	MYSTIC PIERS		MYSTIC RIVER		RESERVED CHANNEL
		HABITAT		HABITAT	HABITAT		HABITAT		HABITAT
		II	III	III	II	IV	III	IV	NONE
NO. OF SAMPLES	TOTAL	3.0	2.0	3.0	2.0	2.0	2.0	3.0	3.0
PORIFERA	HALICHONDRIA PANICEA								
HYDROZOA	CLYTIA GRACILIS							P	
	OBELIA DICHOTOMA								
	OBELIA SP.	P		P			P		
NEMATODA	NEMATODA	25.0							
POLYCHAETA	AMAITIDES SP.								
	ARICIDEA (ACNIRA)								
	CAPITELLIDAE								
	CAPITELLA CAPITATA	8.3							58.3
	CIRRATULIDAE								
	ETEONE LONGA	33.3							
	GLYCERA DIBRANCHIATA	8.3							
	NEDISTE DIVERSICOLOR								16.7
	LEITOSCOLOPLOS ACUTUS								25.0
	LEITOSCOLOPLOS ROBUSTUS								375.0
	LEITOSCOLOPLOS SP.								8.3
	MALDANIDAE	16.7							
	MARENZELLERIA VIRIDIS								8.3
	NEDIONASTUS CALIFORNIENSIS								
	NICROPHTHALMUS ABERRANS	16.7							
	NEANTHES SUCCINEA								
	NEANTHES VIRENS								50.0
	NEPHTYIDAE	8.3	25.0						
	NEPHTYS CAECA	8.3							
	NEPHTYS CILIATA								
	NEPHTYS INCISA								
	NEREIDAE								8.3
	NINOE NIGRIPES	16.7							
	PARANAITIS SPECIOSA								
	PECTINARIA GOULDII								8.3
	PECTINARIIDAE								
	POLYCIRRUS SP.								
	POLYDORA CORNUTA	416.7	12.5					33.3	125.0
	POLYDORA SOCIALIS								
	SPIO FILICORNIS								8.3
	STREBLOSPIO BENEDICTI	166.7				12.5			108.3
	TNARYX ACUTUS	25.0							
OLIGOCHAETA	OLIGOCHAETA	500.0							25.0
GASTROPODA	CREPIDULA FORNICATA								
	CREPIDULA PLANA	33.3							
	CREPIDULA SP.	16.7							
	LACUNA VINCTA	16.7							

TABLE A1-3. (Continued)

GROUP	SPECIES	INNER CONFLUENCE		LITTLE MYSTIC CHANNEL	MYSTIC PIERS		MYSTIC RIVER		RESERVED CHANNEL
		HABITAT		HABITAT	HABITAT		HABITAT		HABITAT
		II	III	III	II	IV	III	IV	NONE
GASTROPODA	NASSARIUS TRIVITTATUS	250.0			37.5	12.5			
BIVALVIA	ANOMIA SP.					12.5			
	BIVALVIA	8.3							
	CERASTODERMA PINNULATUM	8.3							
	MIATELLA SP.	25.0							
	LYONSIA HYALINA	8.3							
	MACOMA BALTHICA								8.3
	MULINIA LATERALIS	8.3		8.3					41.7
	MYA ARENARIA								158.3
	MYTILIDAE	8.3						8.3	8.3
	TELLINA AGILIS								
	TURTONIA MINUTA								
CIRRIPEDIA	BALANUS CRENATUS					12.5			
MYSIDACEA	METEROMYSIS FORMOSA	8.3							
AMPHIPODA	AMPELISCA ABDITA					12.5		8.3	
	CORDPHIUM BONELLI								
	GAMMARUS LAWRENCIANUS			8.3					
	MICRODEUTOPUS GRYLLOTALPA								
	PONTOGENEIA INERMIS	8.3							
	UNCIOLA INERMIS								
DECAPODA	CRANGON SEPTEMSPINOSA								
BRYOZOA	BUGULA TURRITA								
OPHIUROIDEA	OPHIUROIDEA							8.3	
ASCIDIACEA	ASCIDIA SP.								
X NO. OF INDIV	TOTAL	1649.8	37.5	16.6	37.5	62.5		58.2	1041.4
X PORIFERA	TOTAL								
X HYDROZOA	TOTAL	P		P			P	P	
X NEMATODA	TOTAL	25.0							
X POLYCHAETA	TOTAL	725.0	37.5			12.5		33.3	799.8
X OLIGOCHAETA	TOTAL	500.0							25.0
X GASTROPODA	TOTAL	316.7			37.5	12.5			
X BIVALVIA	TOTAL	66.5		8.3		12.5		8.3	216.6
X CIRRIPEDIA	TOTAL					12.5			
X MYSIDACEA	TOTAL	8.3							
X AMPHIPODA	TOTAL	8.3		8.3		12.5		8.3	
X DECAPODA	TOTAL								
X BRYOZOA	TOTAL								
X OPHIUROIDEA	TOTAL							8.3	
X ASCIDIACEA	TOTAL								
NO. OF TAXA	TOTAL	26.0	2.0	3.0	1.0	5.0	1.0	5.0	17.0

TABLE A1-3. (Continued)

GROUP	SPECIES	REVERE SUGAR
		HABITAT
		III
NO. OF SAMPLES	TOTAL	3.0
PORIFERA	HALICHONDRIA PANICEA	
HYDROZOA	CLYTIA GRACILIS	
	OBELIA DICHOTOMA	
	OBELIA SP.	
NEMATODA	NEMATODA	66.7
POLYCHAETA	AMAITIDES SP.	
	ARICIDEA (ACMIRA)	
	CATHERINAE	
	CAPITELLA CAPITATA	
	CIRRATULIDAE	108.3
	ETEONE LONGA	
	GLYCERA DIBRANCHIATA	
	MEDISTE DIVERSICOLOR	
	LEITOSCOLOPLOS ACUTUS	
	LEITOSCOLOPLOS ROBUSTUS	
	LEITOSCOLOPLOS SP.	
	MALDANIDAE	
	MARENZELLERIA VIRIDIS	
	MEDIOMASTUS CALIFORNIENSIS	
	MICROPHTHALMUS ABERRANS	
	NEANTHES SUCCINEA	
	NEANTHES VIRENS	8.3
	NEPHTYIDAE	
	NEPHTYS CAECA	
	NEPHTYS CILIATA	
	NEPHTYS INCISA	
	NEREIDAE	
	NINOE NIGRIPES	
	PARAMAITIS SPECIOSA	
	PECTINARIA GOULDII	
	PECTINARIIDAE	
	POLYCIRRUS SP.	
	POLYDORA CORNUTA	25.0
	POLYDORA SOCIALIS	
	SPIO FILICORNIS	
	STREBLOSPIO BENEDICTI	50.0
	THARYX ACUTUS	25.0
OLIGOCHAETA	OLIGOCHAETA	183.3
GASTROPODA	CREPIDULA FORNICATA	
	CREPIDULA PLANA	
	CREPIDULA SP.	
	LACUNA VINCTA	
	NASSARIUS TRIVITTATUS	

TABLE A1-3. (Continued)

GROUP	SPECIES	REVERE SUGAR
		HABITAT
		III
BIVALVIA	AMONIA SP.	
	BIVALVIA	
	CERASTODERMA PINNULATUM	
	MIATELLA SP.	
	LYONSIA HYALINA	
	MACOMA BALTHICA	
	MULINIA LATERALIS	
	MYA ARENARIA	
	MYTILIDAE	
	TELLINA AGILIS	
	TURTONIA MINUTA	
CIRRIPEDIA	BALANUS CRENATUS	
MYSIDACEA	METEROMYSIS FORMOSA	
AMPHIPODA	AMPELISCA ABDITA	
	CORCPHIUM BONELLI	
	GAMMARUS LAWRENCIANUS	
	MICRODEUTOPUS GRYLLOTALPA	8.3
	PONTOGENEIA INERMIS	
	UNCIOLA INERMIS	
DECAPODA	CRANGON SEPTENSPINOSA	8.3
BRYOZOA	BUGULA TURRITA	
OPHIUROIDEA	OPHIUROIDEA	
ASCIDIACEA	ASCIDIA SP.	
X NO. OF INDIV	TOTAL	483.2
X PORIFERA	TOTAL	
X HYDROZOA	TOTAL	
X NEMATODA	TOTAL	66.7
X POLYCHAETA	TOTAL	216.6
X OLIGOCHAETA	TOTAL	183.3
X GASTROPODA	TOTAL	
X BIVALVIA	TOTAL	
X CIRRIPEDIA	TOTAL	
X MYSIDACEA	TOTAL	
X AMPHIPODA	TOTAL	8.3
X DECAPODA	TOTAL	8.3
X BRYOZOA	TOTAL	
X OPHIUROIDEA	TOTAL	
X ASCIDIACEA	TOTAL	
NO. OF TAXA	TOTAL	9.0

Table A1-4. Standardized mean catch per unit effort(catch per 20 minute trawl) by station in Boston Harbor and Massachusetts Bay, October 1994.

SPECIES	STATION							
	BOSTON-LIGHTSHIP	SUBAQUEOUS-E	SPECTACLE-I. CAD*	INNER-CONFLUENCE*	MYSTIC-RIVER*	CHELSEA-RIVER*	SPECIES-TOTAL	PERCENT-SPECIES-COMPOSITION
ALEWIFE	0.3	0.0	0.0	1.3	4.0	0.0	5.7	2.0
ATLANTIC COD	0.0	1.3	0.0	0.0	0.0	0.0	1.3	0.5
ATLANTIC MOONFISH	0.0	0.0	0.0	0.0	5.3	0.0	5.3	1.9
ATLANTIC SILVERSIDE	0.0	2.3	1.3	1.3	2.7	0.0	7.7	2.7
ATLANTIC TOMCOD	0.0	0.0	0.0	0.0	10.7	16.0	26.7	9.3
BUTTERFISH	4.0	0.0	0.0	0.0	0.0	0.0	4.0	1.4
CUNNER	0.0	0.0	0.0	0.0	1.3	0.0	1.3	0.5
GRUBBY	0.0	0.0	0.0	1.3	0.0	2.7	4.0	1.4
HAKE SP.	1.7	0.0	0.0	0.0	0.0	0.0	1.7	0.6
LOBSTER	37.7	3.7	6.7	2.7	0.0	4.0	54.7	19.0
LONGHORN SCULPIN	0.7	0.0	0.0	0.0	0.0	0.0	0.7	0.2
RAINBOW SMELT	0.0	2.7	4.0	4.0	2.7	0.0	13.3	4.6
SCUP	0.0	0.0	0.0	0.0	9.3	0.0	9.3	3.2
SHORTHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	1.3	1.3	0.5
SILVER HAKE	0.7	0.0	0.0	0.0	0.0	0.0	0.7	0.2
SKATE SP.	0.0	5.0	6.7	1.3	0.0	1.3	14.3	5.0
STRIPED BASS	0.0	0.3	0.0	0.0	0.0	0.0	0.3	0.1
WINDOWPANE	0.0	0.3	0.0	5.3	0.0	0.0	5.7	2.0
WINTER FLOUNDER	17.7	5.0	9.3	22.7	26.7	46.7	128.0	44.5
YELLOWTAIL FLOUNDER	1.7	0.0	0.0	0.0	0.0	0.0	1.7	0.6
STATION TOTAL	64.3	20.7	28.0	40.0	62.7	72.0	287.7	-
PERCENT STATION-COMPOSITION	22.4	7.2	9.7	13.9	21.8	25.0	-	100.0

* Five minute tows standardized to 20-minute tows.

TABLE A1-5. REPRESENTATIVE FINFISH SPECIES LIST, BOSTON INNER AND OUTER HARBOR.

Common Name	Scientific Name
Alewife	*Alosa pseudoharengus*
American plaice	*Hippoglossoides platessoides*
American shad	*Alosa sapidissima*
Atlantic wolfish	*Anarhichas lupus*
Atlantic cod	*Gadus morhua*
Atlantic herring	*Clupea harengus harengus*
Atlantic mackerel	*Scomber scombrus*
Atlantic menhaden	*Brevoortia tyrannus*
Atlantic silverside	*Menidia menidia*
Atlantic tomcod	*Microgadus tomcod*
Bluefish	*Pomatomus saltatrix*
Blueback herring	*Alosa aestivalis*
Butterfish	*Peprilus triacanthus*
Cunner	*Tautoglabrus adspersus*
Cusk	*Brosme brosme*
Grey sole	*Glyptocephalus cynoglossus*
Hake	*Urophycis* sp.
Skate spp.	*Raja* spp.
Longhorn sculpin	*Myoxocephalus octodecemspinosus*
Ocean pout	*Macrozoarces americanus*
Pollock	*Pollachius virens*
Rainbow smelt	*Osmerus mordax*
Redfish	*Sebastes* spp.
Sculpin	*Myoxocephalus* sp.

TABLE A1-5. (CONTINUED)

Common Name	Scientific Name
Scup	*Stenotomus chrysops*
Spiny dogfish	*Squalus acanthias*
Striped bass	*Morone saxatilis*
Tautog	*Tautoga onitis*
Whiting/Silver hake	*Merluccius bilinearis*
Windowpane	*Scophthalmus aqousus*
Winter flounder	*Pleuronectes americanus*
Yellowtail flounder	*Limanda ferruginea*

Table A1-6. Standardized catch per unit effort(fish per 24-hour set) in gill net collections from Boston Harbor and Massachusetts Bay, October 1994.

SPECIES	STATION										
	RESERVED-CHANNEL	CHELSEA 01	FISH PIER	LOGAN 2	LITTLE-MYSTIC-CHANNEL	REVERE-SUGAR	MEIS-BURGER 2	MEIS-BURGER 7	SPECIES-TOTAL	PERCENT-SPECIES-COMP.
ALEWIFE	28.7	-	0.3	-	0.3	0.3	0.7	0.3	30.7	15.0
AMERICAN SHAD	0.7	-	-	-	-	-	-	-	0.7	0.3
ATLANTIC COD	-	-	-	-	-	-	-	1.3	1.3	0.7
ATLANTIC TOMCOD	0.7	-	0.3	-	1.0	-	-	-	2.0	1.0
BLUE RUNNER	0.3	-	-	-	-	-	-	-	0.3	0.2
BLUEBACK HERRING	52.0	0.3	0.7	0.3	-	-	-	-	53.3	26.1
BLUEFISH	3.7	0.3	-	-	-	-	-	-	4.0	2.0
BUTTERFISH	0.3	-	-	-	0.7	-	-	-	1.0	0.5
CUNNER	-	1.7	0.3	-	0.3	-	3.0	0.3	5.7	2.8
GREEN CRAB	-	2.0	-	-	-	-	-	-	2.0	1.0
GRUBBY	-	-	-	0.3	-	-	-	-	0.3	0.2
HAKE SP.	1.0	-	-	-	-	-	-	1.0	2.0	1.0
HORSESHOE CRAB	-	-	-	-	0.3	-	-	-	0.3	0.2
LOBSTER	-	0.3	-	0.3	-	-	5.0	4.3	10.0	4.9
LONGHORN SCULPIN	-	-	-	-	-	-	2.0	0.7	2.7	1.3
MACKEREL	-	-	-	-	-	0.3	6.3	12.3	19.0	9.3
MACKEREL SCAD	0.3	-	-	-	-	-	-	-	0.3	0.2
RAINBOW SMELT	3.3	15.3	18.3	6.3	4.7	3.0	-	-	31.0	25.0
SCUP	-	-	-	-	-	-	-	0.3	0.3	0.2
SILVER HAKE	-	-	-	-	-	-	-	0.3	0.3	0.2
SKATE SP.	1.0	-	-	1.7	-	-	-	0.7	3.3	1.6
SPIDER CRAB	1.0	-	-	-	-	-	-	-	1.0	0.5
STRIPED BASS	1.0	0.3	-	0.7	-	-	-	-	2.0	1.0
WINTER FLOUNDER	2.7	2.0	-	3.7	-	0.3	0.3	-	9.0	4.4
STATION TOTAL	96.7	22.3	20.3	13.7	7.3	4.7	17.3	21.7	204.0	-
PERCENT STATION-COMPOSITION	47.4	10.9	10.0	6.7	3.6	2.3	8.5	10.6	-	100.0

Table A1-7. Catch per unit effort (number/trap-day) by sex for sublegal and legal sized lobsters captured in Boston Harbor, October 1994.

SUBLEGALS

SEX	LOCATION												
	LNCh.	Inner-Conf.	Chel-01	Chel.-Riv.	MystickR.	RevSug.	ResCh	LogO2	Outer-Hbr.	Specls.	Meis#2	Meis#7	BLS
MALES	0.4	0.8	0.0	0.1	0.2	0.1	0.7	0.7	0.0	0.2	2.8	2.3	1.3
FEMALES	0.1	0.1	0.1	0.0	0.0	0.1	0.6	0.1	0.0	0.0	3.5	2.7	1.5
TOTAL	0.6	0.9	0.1	0.1	0.2	0.2	1.2	0.8	0.0	0.2	6.3	5.0	2.8

LEGALS

SEX	LOCATION												
	LNCh.	Inner-Conf.	Chel-01	Chel.-Riv.	MystickR.	RevSug.	ResCh	LogO2	Outer-Hbr.	Specls.	Meis#2	Meis#7	BLS
MALES	0.6	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.1	0.1	0.1
FEMALES	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
TOTAL	0.6	0.0	0.0	0.1	0.0	0.1	0.2	0.1	0.0	0.0	0.1	0.1	0.1

TOTAL

SEX	LOCATION												
	LNCh.	Inner-Conf.	Chel-01	Chel.-Riv.	MystickR.	RevSug.	ResCh	LogO2	Outer-Hbr.	Specls.	Meis#2	Meis#7	BLS
MALES	1.0	0.8	0.0	0.1	0.2	0.2	0.9	0.7	0.0	0.2	2.9	2.4	1.4
FEMALES	0.1	0.1	0.1	0.1	0.0	0.1	0.6	0.2	0.0	0.0	3.5	2.7	1.5
TOTAL	1.1	0.9	0.1	0.2	0.2	0.3	1.4	0.9	0.0	0.2	6.4	5.1	2.9

TABLE A1-8. SHORELINE SITE FOOTPRINT

SITE	FOOTPRINT (acres)
Amstar	3.5
Cabot Paint	5.6
Little Mystic Ch.	15.0
Mystic Piers	2.7
Reserved Channel	7.7-16.6
Revere Sugar	3.7

TABLE A1-9. SEDIMENT CHARACTERISTICS IN THE VICINITY OF POTENTIAL DISPOSAL SITE EAST OF SPECTACLE ISLAND, 1988[a].

PARAMETER[a]	ST1-7 (0-2')[b]	ST1-8 (0-1')	ST1-8 (1-6.25')	ST1-9 (0-2')	ST1-11 (0-2')	ST1-12 (0-1.5')
Arsenic	9.2	14.8	27.8	3.8	2.5	13.1
Cadmium	0.7	0.8	0.8	<0.5	0.8	2.8
Chromium	16.0	19.2	25.3	12.1	19.1	20.9
Copper	8.7	18.0	17.1	5.3	22.4	14.1
Lead	7.5	14.4	10.1	9.5	16.1	11.7
Mercury	<0.01	0.06	<0.01	0.02	0.11	0.06
Nickel	15.5	15.8	23.5	10.5	20.1	22.8
Vanadium	22	23	39	17	20	37
Zinc	32.2	35.8	41.2	64.0	37.7	53.8
% Water	27	26	37	27.6	24	20
% Volatile Solids	3	2	2	0.8	9	2
% Oil and Grease	0.042	0.032	0.020	0.080	0.025	<0.010
Total Petroleum Hydrocarbons	<100	200	100	<100	<100	<100
% Total Organic Carbon	0.52	1.40	1.20	0.60	0.64	0.77
Polychlorinated Biphenyls	TR	0.02	ND	ND	TR	ND
% Silt/Clay	48	23	50	31	21	7
Classification	1A	2A	3A	1A	1B	2A

Source: Cortell 1990b
[a]All results in mg/kg (ppm) dry weight unless otherwise noted.
[b]Depth below sediment surface
TR = Traces below detection limit
ND = Not detected

TABLE A1-10. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM OUTER BOSTON HARBOR LOCATIONS, OCTOBER 1994.

GROUP	SPECIES	SPECTACLE ISLAND		SUBAQUEOUS B	SUBAQUEOUS E	
		HABITAT		HABITAT	HABITAT	
		I	II	I	I	II
NO. OF SAMPLES	TOTAL	4.0	1.0	3.0	2.0	1.0
HYDROZOA	CLYTIA GRACILIS				P	
	EUDENORIUM RUGOSUM				P	
	SERTULARIA CUPRESSINA	P		P	P	
NEMERTINEA	NEMERTINEA	62.5		166.7	25.0	
NEMATODA	NEMATODA	1325.0	325.0	483.3	2012.5	50.0
POLYCHAETA	AGLAOPHAMUS NEOTENUS		50.0		25.0	
	AMPHARETE ARCTICA	6.3				
	AMPHARETIDAE	6.3				
	AMAITIDES MUCOSA	650.0	300.0	2075.0	625.0	
	AMOROTHRUS GRACILIS	6.3				
	APHELOCHAETA MARIONI				287.5	
	ARICIDEA (ACHIRA)					
	CATHERINAE	9668.8	3075.0	1041.7		
	ARICIDEA SP.			8.3	12.5	
	ASABELLIDES OCULATA	143.8	150.0	41.7	212.5	25.0
	CAPITELLA CAPITATA	81.3	25.0	108.3	537.5	
	CIRRATULIDAE	1787.5	450.0	483.3	3362.5	25.0
	CIRRATULUS CIRRATUS				12.5	
	CLYMENELLA TORQUATA		200.0	8.3	25.0	
	EUPIO TORELLI			16.7		
	ETEONE LONGA	381.3	100.0	300.0	1087.5	
	EUCHONE ELEGANS		25.0			
	EULALIA VIRIDIS			8.3		
	GATTYANA CIRROSA		50.0	16.7		
	HARMOTHOE IMBRICATA			41.7	87.5	
	LEITOSCOLOPLOS ACUTUS					50.0
	MALDANIDAE				37.5	
	MEDIOMASTUS CALIFORNIENSIS	568.8	200.0	533.3	462.5	
	MICROPHTHALMUS ABERRANS		25.0		12.5	
	NEANTHES VIRENS			16.7	75.0	25.0
	NEPHTYIDAE	6.3				
	NEPHTYS CAECA	6.3	675.0			25.0
	NEPHTYS CILIATA	206.3	325.0	25.0	75.0	200.0
	NEPHTYS INCISA			8.3	12.5	
	NEREIDAE	12.5				
	NICOLEA ZOSTERICOLA			8.3		
	NINOE NIGRIPES	175.0	50.0	41.7	50.0	150.0
	PARANAITIS SPECIOSA	6.3	25.0		12.5	
	PHERUSA AFFINIS			41.7		
	PHOLOE MINUTA	100.0		125.0	475.0	
	PHYLLODOCIDAE			8.3		
	POLYDORA CORNUTA	4706.3	14400.0	4625.0	9300.0	
	POLYDORA QUADRILOBATA	25.0	1850.0	8.3		

TABLE A1-10. (Continued)

GROUP	SPECIES	SPECTACLE ISLAND HABITAT		SUBAQUEOUS B HABITAT	SUBAQUEOUS E HABITAT	
		I	II	I	I	II
POLYCHAETA	POLYDORA SOCIALIS	18.8	1175.0	8.3	12.5	
	POLYDORA WEBSTERI	6.3				
	PRIONOSPIO STEENSTRUPI	6.3		8.3	75.0	
	SCOLELEPIS TEXANA		75.0			
	SCOLETOMA ACICULARUM		25.0		25.0	
	SCOLETOMA NEBES			500.0		
	SPIO FILICORNIS	6.3				
	SPIO LIMICOLA		25.0			
	SPIO SP.	25.0	25.0	16.7	25.0	
	SPIO TRULINI	18.8	175.0	66.7	262.5	
	SPIONIDAE		50.0	16.7		
	SPIOPHANES BOMBYX		25.0			
	STREBLOSPIO BENEDICTI	81.3	11800.0	16.7	550.0	25.0
	TEREBELLIDAE				12.5	
	THARYX ACUTUS	1543.8	575.0	1733.3	6025.0	
OLIGOCHAETA	OLIGOCHAETA	1475.0	250.0	1033.3	287.5	50.0
GASTROPODA	GASTROPODA	50.0		50.0	125.0	
	LACUNA VINCTA	12.5			25.0	
	NASSARIUS TRIVITTATUS		200.0		287.5	250.0
BIVALVIA	BIVALVIA	25.0		33.3	62.5	
	CERASTODERMA PINNULATUM			8.3		
	LYONSIA HYALINA		25.0	33.3		
	MYA ARENARIA				25.0	25.0
	MYSELLA PLANULATA			8.3	37.5	
	MYTILIDAE	31.3	25.0	41.7	150.0	50.0
	TELLINA AGILIS		50.0		125.0	
CIRRIPEDIA	CIRRIPEDIA			8.3		
MYSIDACEA	METERYTHROPS ROBUSTA	6.3				
	MYSIDACEA	6.3		25.0		
	NEOMYSIS AMERICANA			33.3		
CUMACEA	DIASTYLIS SP.			8.3		
ISOPODA	CHIRIDOTEA SP.	6.3				
	CYATHURA POLITA	6.3				
	EDOTEA TRILOBA	37.5	50.0	116.7	25.0	
AMPHIPODA	AMPELISCA SP.	36537.5	61675.0	94358.3	23075.0	
	AMPHIPODA	6.3				
	COROPHIUM BONELLI	700.0	75.0			
	COROPHIUM CRASSICORNE	56.3				
	COROPHIUM SP.	50.0				
	ERICTHONIUS FASCIATUS	6.3				
	GAMMARUS SP.	87.5			12.5	
	JASSA MARMORATA	6.3	25.0			
	LEPTOCHEIRUS PINGUIS	1250.0	3100.0	1883.3	637.5	
	LEPTOCHEIRUS SP.			8.3		

TABLE A1-10. (Continued)

GROUP	SPECIES	SPECTACLE ISLAND		SUBAQUEOUS B	SUBAQUEOUS E	
		HABITAT		HABITAT	HABITAT	
		I	II	I	I	II
AMPHIPODA	LYSIANASSIDAE	31.3		108.3		
	ONCHOMENELLA PINGUIS	6.3		33.3		
	PHOTIS POLLEX	81.3		16.7		
	PHOXOCEPHALUS HOLBOLLI	2062.5	125.0	2850.0	212.5	
	PHOXOCEPHALUS SP.			8.3		
	UNCIOLA IRRORATA	368.8	175.0	1550.0		
	UNCIOLA SP.	306.3		266.7	37.3	
DECAPODA	CANCER IRRORATUS	6.3		33.3	12.5	25.0
	CRANGON SEPTEMSPINOSA	6.3		25.0	37.5	
	DECAPODA	6.3				
BRYOZOA	BUGULA TURRITA			P		
	MEMBRANIPORA MEMBRANACEA	P				
	PEDICELLINA CERNUA			P		
	SCRUPARIA AMBIGUA					P
X NO. OF INDIV	TOTAL	64870.6	102025.0	115149.6	50987.3	975.0
X HYDROZOA	TOTAL	P		P	P	
X NEMERTINEA	TOTAL	62.5		166.7	25.0	
X NEMATODA	TOTAL	1325.0	325.0	483.3	2012.5	50.0
X POLYCHAETA	TOTAL	20251.0	35925.0	11958.3	23775.0	525.0
X OLIGOCHAETA	TOTAL	1475.0	250.0	1033.3	287.5	50.0
X GASTROPODA	TOTAL	62.5	200.0	50.0	437.5	250.0
X BIVALVIA	TOTAL	56.3	100.0	124.9	400.0	75.0
X CIRRIPEDIA	TOTAL			8.3		
X MYSIDACEA	TOTAL	12.6		58.3		
X CUMACEA	TOTAL			8.3		
X ISOPODA	TOTAL	50.1	50.0	116.7	25.0	
X AMPHIPODA	TOTAL	41556.7	65175.0	101083.2	23975.0	
X DECAPODA	TOTAL	18.9		58.3	50.0	25.0
X BRYOZOA	TOTAL	P		P		P
NO. OF TAXA	TOTAL	59.0	41.0	60.0	51.0	15.0

TABLE A1-11. MEAN ABUNDANCE (NO./m²) BY HABITAT OF BENTHIC INFAUNA RETAINED ON A 0.5mm-MESH SIEVE COLLECTED FROM OFFSHORE LOCATIONS, OCTOBER 1994.

GROUP	SPECIES	BOSTON LIGHTSHIP		NEISBURGER 2			NEISBURGER 7		
		HABITAT		HABITAT			HABITAT		
		VII	VIII	V	VII	VIII	V	VI	VII
NO. OF SAMPLES	TOTAL	8.0	3.0	1.0	6.0	2.0	2.0	4.0	1.0
PORIFERA	SCYPHA CILIATA				12.5				
HYDROZOA	CLYTIA GRACILIS		P						
	EUDENDRIUM RUGOSUM				P				
	EUDENDRIUM SP.				P				
	SERTULARIA CUPRESSINA	P			P		P		
ANTHOZOA	ANTHOZOA	25.0			20.8				25.0
	CERIANTHEOPSIS AMERICANUS		8.3	25.0	12.5		12.5		25.0
	CERIANTHEOPSIS SP.				16.7				
	EDWARDSIA SP.	9.4	41.7	50.0	66.7	62.5	25.0		100.0
NEMERTINEA	NEMERTINEA	62.5	50.0		137.5	162.5	12.5	31.3	
NEMATODA	NEMATODA	71.9			91.7			31.3	
ARCHIANNELIDA	ARCHIANNELIDA				45.8			12.5	
POLYCHAETA	AGLAOPHAMUS CIRCINATA	3.1		50.0	12.5	37.5		6.3	300.0
	AMPHARETE ACUTIFRONS	53.1	8.3						
	AMPHARETE ARCTICA	75.0	33.3	25.0	112.5	75.0	37.5	6.3	25.0
	AMPHARETE SP.	9.4							
	AMPHARETIDAE	25.0	16.7		29.2	87.5	37.5	31.3	125.0
	AMPHITRITE CIRRATA				4.2				
	ANAITIDES ARENAE	3.1							
	ANAITIDES MACULATA	28.1		725.0	37.5	50.0	37.5	25.0	
	ANAITIDES MUCOSA	6.3		150.0	29.2		12.5	18.8	75.0
	ANOBOTHRUS GRACILIS	140.6	433.3		29.2	25.0	12.5	6.3	
	APHELOCHAETA MARIONI	171.9	308.3		858.3	1950.0	12.5	12.5	50.0
	APHELOCHAETA MONILARIS	3.1			29.2	75.0		6.3	
	APISTOBRANCHUS TULLBERGI	3.1							
	ARCTEDORA ANTICOSTIENSIS	12.5	8.3		4.2	12.5			
	ARICIDEA (ACMIRA)								
	CATMERINAE				50.0	37.5	275.0	75.0	25.0
	ARICIDEA QUADRILOBATA	28.1							
	ASABELLIDES OCULATA	331.3	91.7	175.0	337.5	400.0	225.0	368.8	975.0
	BARANTOLLA AMERICANA				4.2				
	CAPITELLA CAPITATA	6.3			50.0	175.0			50.0
	CAULLERIELLA CF.								
	KILLARIENSIS							12.5	
	CHAETOZONE SETOSA	21.9	8.3	400.0	25.0	62.5		6.3	125.0
	CHONE DUNERI					12.5		6.3	
	CIRRATULIDAE	3.1	8.3	350.0	16.7	100.0	200.0	25.0	75.0
	CIRRATULUS CIRRATUS	3.1			4.2	12.5	12.5		
	COSSURA LONGOCIRRATA	3.1							
	DRILONEREIS LONGA	6.3	33.3		4.2				
	DRILONEREIS MAGNA						12.5		
	EHIPO TORELLI	9.4	8.3					6.3	
	ETEONE LONGA	43.8		100.0	41.7	12.5		6.3	
	EUCHONE ELEGANS			1050.0	54.2	2437.5	112.5	331.3	175.0

TABLE A1-11. (Continued)

GROUP	SPECIES	BOSTON LIGHTSHIP		NEISBURGER 2			NEISBURGER 7		
		HABITAT		HABITAT			HABITAT		
		VII	VIII	V	VII	VIII	V	VI	VII
POLYCHAETA	EUCHONE INCOLOR	12.5							
	EUCHONE SP.				125.0			56.3	
	EUCLYMENE COLLARIS	12.5		475.0	200.0	725.0	450.0	575.0	975.0
	EULALIA GILINEATA					12.5			
	EUSYLLIS SP.							12.5	
	EXOGONE OISPAR				4.2		37.5	18.8	
	EXOGONE NEBES					50.0		6.3	
	EXOGONE SP.				8.3	25.0	50.0	18.8	
	EXOGONE VERUGERA	6.3		150.0	29.2	187.5	287.5	412.5	25.0
	GALATHOWEMIA OCULATA	46.9	116.7		12.5		12.5		
	GATTYANA AMONDSENI	15.6	8.3		12.5	12.5			
	GATTYANA CIRROSA				16.7				
	GLYCERA CAPITATA			50.0	16.7		37.5	112.5	
	GONIADA MACULATA	31.3			8.3	12.5			
	HARMOTHOE IMBRICATA	3.1			16.7			6.3	
	HETEROMASTUS FILIFORMIS	9.4	8.3	25.0					
	LAGISCA EXTENUATA		8.3		4.2			18.8	
	LAONICE CIRRATA				16.7				
	LAONOME KROYERI	37.5	33.3	150.0	8.3	37.5			
	LEITOSCOLOPLOS ACUTUS	56.3	16.7	75.0	154.2	100.0		6.3	
	LEVINSENIA GRACILIS	193.8	33.3		25.0		100.0	50.0	
	LYSILLA LOVENI	15.6							
	MALDANE SARSI	56.3	441.7		308.3	37.5	37.5		
	MALDANIDAE	93.8	50.0	100.0		25.0		93.8	
	MARENZELLERIA VIRIDIS	3.1							
	MEDIOMASTUS CALIFORNIENSIS	631.3	41.7	400.0	600.0	800.0	37.5	81.3	25.0
	MICROPHTHALMUS ABERRANS				4.2				
	MINUSPIO CIRRIFERA	9.4						6.3	
	MONTICELLINA BAPTISTAE								
	MONTICELLINA								
	DORSOBRANCHIALIS	3.1		25.0	25.0	12.5	37.5	37.5	
	MYRIOCHELE HEERI	9.4	8.3			12.5			
	NEPHTYIDAE				4.2				
	NEPHTYS CAECA					12.5			25.0
	NEPHTYS CILIATA					50.0			
	NEPHTYS INCISA	56.3	58.3		8.3		12.5		
	NEREIS GRAYI	3.1				12.5			
	NEREIS SP.	18.8			29.2	112.5			25.0
	NEREIS ZONATA	3.1				25.0			
	NINOE NIGRIPES	118.8	125.0	25.0	250.0	250.0	450.0	75.0	25.0
	OPHELINA ACUMINATA	3.1							
	ORBINIIDAE	3.1							
	OWENIA FUSIFORMIS		16.7		12.5	25.0			
	PARADONEIS LYRA						37.5		25.0

TABLE A1-11. (Continued)

GROUP	SPECIES	BOSTON LIGHTSHIP		MEISBURGER 2			MEISBURGER 7		
		HABITAT		HABITAT			HABITAT		
		VII	VIII	V	VII	VIII	V	VI	VII
POLYCHAETA	PARAPIONOSYLLIS								
	LONGICIRRATA							6.3	
	PECTINARIA GRANULATA				25.0	12.5			
	PHERUSA AFFINIS					37.5			
	PHOLOE MINUTA	12.5	8.3	75.0	33.3		37.5	31.3	
	PHYLLODOCIDAE				16.7				
	POLTCIRRUS MEDUSA							6.3	
	POLYCIRRUS PHOSPHOREUS	3.1			4.2				
	POLYCIRRUS SP.	6.3	16.7	50.0	20.8		12.5		
	POLYDORA CAULLERYI			50.0	8.3	12.5	312.5	6.3	
	POLYDORA CONCHARUM		16.7						
	POLYDORA CORNUTA				4.2				
	POLYDORA QUADRILOBATA			1225.0	991.7	4025.0	37.5		25.0
	POLYDORA SOCIALIS	103.1	33.3	925.0	816.7	1337.5	787.5	62.5	400.0
	POLYDORA SP.						12.5	6.3	
	POLYNOIDAE							6.3	
	PRAXILLELLA PRAETERMISSA		33.3		45.8			18.8	
	PRAXILLURA ORNATA	90.6							
	PRIONOSPIO STEENSTRUPI	537.5	66.7	1125.0	250.0	812.5	12.5	12.5	100.0
	PROTODORVILLEA GASPEENSIS							6.3	
	RHODINE BITORQUATA	25.0		25.0		75.0			
	SABELLIDAE	3.1	16.7	100.0	8.3	112.5		287.5	600.0
	SCALIBREGMA INFLATUM	203.1	41.7	150.0	170.8	112.5			
	SCHISTOMERINGOS CAECA							6.3	
	SCOLETOMA ACICULARUM							6.3	
	SCOLETOMA FRAGILIS	15.6	66.7		29.2	37.5	12.5		
	SCOLETOMA NEBES	3.1							
	SCOLOPLOS ARMIGER	15.6	8.3		8.3	50.0			100.0
	SPHAEROSYLLIS SP.							12.5	
	SPIO FILICORNIS			25.0	20.8	25.0	25.0		
	SPIO LIMICOLA	4268.8	991.7	50.0	541.7	675.0	150.0	31.3	675.0
	SPIO SETOSA				4.2				
	SPIO SP.	56.3	25.0		20.8		12.5	12.5	
	SPIO THULINI	3.1		100.0	66.7	50.0	62.5	87.5	75.0
	SPIONIDAE	50.0	25.0	25.0	45.8	50.0	12.5	6.3	
	SPIOPHANES BOMBYX			25.0	16.7	37.5		12.5	1100.0
	SPIOPHANES KROYERI	15.6	58.3			12.5			
	STERNAPSIS SCUTATA	3.1	8.3						
	SYLLIDAE					12.5			
	SYLLIS								
	(TYPOSYLLIS)ALTERNATA				33.3				
	TEREBELLIDAE	18.8	8.3						
	TEREBELLIDES ATLANTIS	21.9	16.7						
	TEREBELLIDES STROEMI	15.6	41.7						
	THARYX ACUTUS	15.6		100.0	25.0	50.0	75.0	200.0	25.0

TABLE A1-11. (Continued)

GROUP	SPECIES	BOSTON LIGHTSHIP		MEISBURGER 2			MEISBURGER 7		
		HABITAT		HABITAT			HABITAT		
		VII	VIII	V	VII	VIII	V	VI	VII
POLYCHAETA	TRICHOBRANCHUS ROSEUS	3.1	25.0						
	TROCHOCHAETA MULTISETOSA	12.5							
	TROCHOCHAETA SP.				8.3				
	TYPOSYLLIS SP.			50.0	12.5	37.5			
OLIGOCHAETA	OLIGOCHAETA	3.1			12.5		25.0	25.0	
GASTROPODA	ALVANIA EXARATA		8.3		12.5				
	BUCCINUM UNDATUM				4.2		12.5		
	COLUS PUBESCENS	9.4	8.3						
	COLUS SP.	12.5							
	CREPIDULA FORNICATA							12.5	
	GASTROPODA	3.1	8.3						
	LACUNA VINCTA			25.0	8.3				
	LUNATIA HEROS					12.5			
	MARGARITES HELICINUS			50.0					
	NASSARIUS TRIVITTATUS			125.0	4.2	25.0		6.3	50.0
	OENOPOTA DECUSSATA	3.1							
	RETUSA OBTUSA	3.1							
	TURRIDAE				4.2				
POLYPLACOPHORA	ISCHNOCHITON ALBUS							6.3	
BIVALVIA	ANOMIA SP.			25.0	20.8			12.5	
	ARCTICA ISLANDICA	3.1							
	ASTARTE BOREALIS							18.8	
	ASTARTE SP.								25.0
	ASTARTE UNDATA	34.4	58.3	25.0	37.5	62.5		18.8	
	BIVALVIA	12.5	16.7		4.2	37.5	25.0	6.3	125.0
	CERASTODERMA PINNULATUM	9.4	108.3	75.0	162.5	62.5	37.5	143.8	75.0
	CREMELLA DECUSSATA	15.6	41.7		250.0	175.0	12.5	100.0	
	CREMELLA GLANDULA				25.0		12.5	93.8	25.0
	CREMELLA SP.			25.0	37.5			25.0	
	NIATELLA SP.			25.0	25.0			12.5	
	LYONSIA HYALINA				4.2				
	MUSCULUS NIGER				8.3	12.5		6.3	
	MYA ARENARIA	6.3	33.3	25.0	16.7				
	MYSELLA PLANULATA	9.4			4.2				
	MYTILIDAE	3.1		50.0	20.8	12.5		31.3	
	NUCULA SP.			25.0					
	NUCULA TENUIS	21.9	25.0		166.7	387.5	50.0		
	PECTINIDAE						12.5		
	PERIPLOMA LEAMUM	3.1	8.3						
	PERIPLOMA SP.								
	PLACOPECTEN MAGELLANICUS							6.3	
	THRACIA MYOPSIS	6.3			4.2				
	THYASIRA FLEXUOSA	234.4	350.0		208.3	87.5			
	YOLDIA SAPOTILLA	62.5	33.3		16.7				
	YOLDIA SP.	40.6	41.7		8.3	25.0			

TABLE A1-11. (Continued)

GROUP	SPECIES	BOSTON LIGHTSHIP		REISBURGER 2			REISBURGER 7		
		HABITAT		HABITAT			HABITAT		
		VII	VIII	V	VII	VIII	V	VI	VII
CIRRIPEDIA	CIRRIPEDIA				4.2				
MYSIDACEA	MYSIDACEA	9.4		75.0	16.7	12.5		6.3	
CUMACEA	CAMPYLASPIS RUBICUNDA	15.6			4.2				25.0
	DIASTYLIS ABBREVIATA	6.3				25.0			
	DIASTYLIS BISPINOSA	31.3							
	DIASTYLIS SCULPTA				8.3				
	EUDORELLA PUSILLA	3.1							
	PETALOSARSIA DECLIVIS				4.2				
ISOPODA	EDOTEA TRILOBA	40.6	33.3	50.0	50.0	75.0			100.0
	JAERA MARINA	3.1						6.3	
	PLEUROGONIUM SPINOSISSIMUM		8.3		8.3				
	POLITOLANA CONCHARUM								25.0
	PTILANTHURA SP.				58.3	112.5			
AMPHIPODA	AEGININA LONGICORNIS				16.7				
	AMPELISCA MACROCEPHALA	43.8			8.3	25.0			
	AMPELISCA SP.	6.3					12.5	18.8	
	AMPHIPODA	3.1							
	ANONYX LILJEBORGI	18.8			16.7	12.5			
	ANONYX SARSI						12.5	6.3	
	ARGISSA HAMATIPES				4.2				125.0
	BYBLIS SERRATA	3.1	8.3						
	CASCO BIGELOWI				4.2				
	COROPHIIDAE		8.3						
	COROPHIUM CRASSICORNE			100.0	8.3	162.5	37.5	12.5	25.0
	ERICHTHONIUS FASCIATUS	6.3			62.5	150.0			
	ERICHTHONIUS SP.				12.5			12.5	
	GAMMARUS LAWRENCIANUS				4.2				
	GAMMARUS SP.	6.3							
	HAPLOOPS SP.		16.7		4.2				
	HAPLOOPS TUBICOLA	81.3	175.0		212.5	162.5			
	HARPINIA PROPINQUA	18.8	25.0		8.3	25.0			
	HIPPOMEDON SERRATUS	6.3	8.3		12.5				25.0
	JASSA MARMORATA							6.3	
	LEMBOS WEBSTERI			400.0	75.0		50.0	56.3	25.0
	LEPTOCHEIRUS PINGUIS	15.6	108.3	25.0	62.5	125.0	25.0	6.3	
	LYSIANASSIDAE				4.2	25.0			
	MONOCULODES SP.	3.1						6.3	
	MONOCULODES TUBERCULATUS				4.2		25.0	12.5	
	OEDICEROTIDAE							25.0	
	PHOTIS POLLEX				4.2	12.5			
	STENOPLEUSTES SP.				4.2				
	SYRRHOE CREMULATA						25.0	6.3	25.0
	UNCIOLA INERMIS			1250.0	129.2		50.0	1618.8	
	UNCIOLA IRRORATA	6.3			37.5		312.5	550.0	25.0
	UNCIOLA SP.				50.0	100.0		43.8	

TABLE A1-11. (Continued)

GROUP	SPECIES	BOSTON LIGHTSKIP		MEISBURGER 2			MEISBURGER 7		
		HABITAT		HABITAT			HABITAT		
		VII	VIII	V	VII	VIII	V	VI	VII
DECAPODA	CANCER IRRORATUS							6.3	
	PAGURUS LONGICARPUS				4.2				
SIPUNCULA	GOLFINGIA SP.		6.3						
	SIPUNCULA	15.6			8.3				
PHORONIDA	PHORONIS ARCHITECTA	34.4	16.7	25.0	258.3	87.5	37.5	12.5	75.0
BRYOZOA	ANGUINELLA PALMATA				P				
	BUGULA TURRITA		P						
	CRISIA EBURNEA				P				
	ELECTRA PILOSA				P				
	EUCRATEA LORICATA	P			P				
	HIPPOTHOA HYALINA	P			P	P			
OPHIUROIDEA	OPHIOPHOLIS ACULEATA				4.2				
	OPHIURA ROBUSTA				4.2				
	OPHIURA SARSI	62.5	33.3			12.5			
	OPHIUROIDEA	6.3			8.3				
ECHINOIDEA	STRONGYLOCENTROTUS DROEBACHIENSIS				4.2			18.8	
CHORDATA	CHORDATA				4.2				
ASCIDIACEA	APLIDIUM SP.		P						
	ASCIDIA SP.		6.3						
	CORELLA BOREALIS	6.3			4.2				
X NO. OF INDIV	TOTAL	9066.5	4732.7	11075.0	9534.4	17925.0	4962.5	6396.7	7150.0
X PORIFERA	TOTAL				12.5				
X HYDROZOA	TOTAL	P	P		P		P		
X ANTHOZOA	TOTAL	34.4	50.0	75.0	116.7	62.5	37.5		150.0
X NEMERTINEA	TOTAL	62.5	50.0		137.5	162.5	12.5	31.3	
X NEMATODA	TOTAL	71.9			91.7			31.3	
X ARCHIANNELIDA	TOTAL				45.8			12.5	
X POLYCHAETA	TOTAL	7947.2	3433.1	8600.0	6863.0	15675.0	4137.5	3366.2	6225.0
X OLIGOCHAETA	TOTAL	3.1			12.5		25.0	25.0	
X GASTROPODA	TOTAL	31.2	24.9	200.0	33.4	37.5	12.5	18.8	50.0
X POLYPLACOPHORA	TOTAL							6.3	
X BIVALVIA	TOTAL	462.6	716.6	275.0	1020.9	862.5	150.0	475.4	250.0
X CIRRIPEDIA	TOTAL				4.2				
X MYSIDACEA	TOTAL	9.4		75.0	16.7	12.5		6.3	
X CUMACEA	TOTAL	56.3			16.7	25.0			25.0
X ISOPODA	TOTAL	45.7	41.6	50.0	116.6	187.5		6.3	125.0
X AMPHIPODA	TOTAL	219.1	349.9	1775.0	746.1	800.0	550.0	2381.7	250.0
X DECAPODA	TOTAL				4.2			6.3	
X SIPUNCULA	TOTAL	15.6	8.3		8.3				
X PHORONIDA	TOTAL	34.4	16.7	25.0	258.3	87.5	37.5	12.5	75.0
X BRYOZOA	TOTAL	P	P		P	P			
X OPHIUROIDEA	TOTAL	68.8	33.3		16.7	12.5			
X ECHINOIDEA	TOTAL				4.2			18.8	
X CHORDATA	TOTAL				4.2				
X ASCIDIACEA	TOTAL	6.3	8.3		4.2				
NO. OF TAXA	ZTOTAL	125.0	76.0	35.0	150.0	88.0	61.0	92.0	45.0

TABLE A1-11. (Continued)

GROUP	SPECIES	MEISBURGER 7
		HABITAT
		VIII
NO. OF SAMPLES	TOTAL	2.0
PORIFERA	SCYPHA CILIATA	
HYDROZOA	CLYTIA GRACILIS	
	EUDENDRIUM RUGOSUM	
	EUDENDRIUM SP.	
	SERTULARIA CUPRESSINA	P
ANTHOZOA	ANTHOZOA	
	CERIANTHEOPSIS AMERICANUS	62.5
	CERIANTHEOPSIS SP.	
	EDWARDSIA SP.	
NEMERTINEA	NEMERTINEA	50.0
NEMATODA	NEMATODA	
ARCHIANNELIDA	ARCHIANNELIDA	
POLYCHAETA	AGLAOPHAMUS CIRCINATA	
	AMPHARETE ACUTIFRONS	
	AMPHARETE ARCTICA	25.0
	AMPHARETE SP.	
	AMPHARETIDAE	
	AMPHITRITE CIRRATA	
	AMAITIDES AREMAE	
	AMAITIDES MACULATA	
	AMAITIDES MUCOSA	
	AMOBOTHRUS GRACILIS	
	APHELOCHAETA MARIONI	75.0
	APHELOCHAETA MONILARIS	
	APISTOBRANCHUS TULLBERGI	
	ARCTEOBIA ANTICOSTIENSIS	
	ARICIDEA (ACHIRA)	
	CATHERINAE	37.5
	ARICIDEA QUADRILOBATA	
	ASABELLIDES OCULATA	12.5
	BARANTOLLA AMERICANA	
	CAPITELLA CAPITATA	12.5
	CAULLERIELLA CF.	
	KILLARIENSIS	
	CHAETOZONE SETOSA	
	CHONE DUMERI	
	CIRRATULIDAE	112.5
	CIRRATULUS CIRRATUS	
	COSSURA LONGOCIRRATA	
	DRILONEREIS LONGA	
	DRILONEREIS MAGNA	
	ENIPO TORELLI	12.5
	ETEONE LONGA	12.5

TABLE A1-11. (Continued)

GROUP	SPECIES	MEISBURGER 7
		HABITAT
		VIII
POLYCHAETA	EUCHONE ELEGANS	
	EUCHONE INCOLOR	
	EUCHONE SP.	
	EUCLYMENE COLLARIS	
	EULALIA BILINEATA	
	EUSTILIS SP.	
	EXOGONE DISPAR	
	EXOGONE HEBES	
	EXOGONE SP.	
	EXOGONE VERUGERA	
	GALATHOWENIA OCULATA	
	GATTYANA AMONDSENI	
	GATTYANA CIRROSA	
	GLYCERA CAPITATA	
	GONIADA MACULATA	
	HARMOTHOE IMBRICATA	
	HETEROMASTUS FILIFORMIS	
	LAGISCA EXTENUATA	
	LAONICE CIRRATA	
	LAONOME KROYERI	
	LEITOSCOLOPLOS ACUTUS	62.5
	LEVINSENIA GRACILIS	125.0
	LYSILLA LOVENI	
	MALDANE SARSI	37.5
	MALDANIDAE	12.5
	MARENZELLERIA VIRIDIS	
	MEDIOMASTUS CALIFORNIENSIS	237.5
	MICROPHTHALMUS ABERRANS	
	MINUSPID CIRRIFERA	
	MONTICELLINA BAPTISTAE	25.0
	MONTICELLINA	
	DORSOBRANCHIALIS	75.0
	MYRIOCHELE HEERI	
	NEPHTYIDAE	
	NEPHTYS CAECA	
	NEPHTYS CILIATA	
	NEPHTYS INCISA	62.5
	NEREIS GRAYI	
	NEREIS SP.	
	NEREIS ZONATA	
	NINOE NIGRIPES	700.0
	OPHELINA ACUMINATA	
	ORBINIIDAE	
	OWENIA FUSIFORMIS	

TABLE A1-11. (Continued)

GROUP	SPECIES	REISBURGER 7 HABITAT VIII
POLYCHAETA	PARADONEIS LYRA	
	PARAPIONOSYLLIS	
	LONGICIRRATA	
	PECTINARIA GRANULATA	
	PHERUSA AFFINIS	
	PHOLOE MINUTA	25.0
	PHYLLODOCIDAE	
	POLYCIRRUS MEDUSA	
	POLYCIRRUS PHOSPHOREUS	
	POLYCIRRUS SP.	
	POLYDORA CAULLERYI	
	POLYDORA CONCHARUM	
	POLYDORA CORNUTA	
	POLYDORA QUADRILOBATA	
	POLYDORA SOCIALIS	
	POLYDORA SP.	
	POLYNOIDAE	
	PRAXILLELLA PRAETERMISSA	
	PRAXILLURA ORNATA	
	PRIONOSPIO STEENSTRUPI	12.5
	PROTODORVILLEA GASPEENSIS	
	RHODINE BITORQUATA	
	SABELLIDAE	
	SCALIBREGMA INFLATUM	
	SCHISTOMERINGOS CAECA	
	SCOLETOMA ACICULARUM	
	SCOLETOMA FRAGILIS	12.5
	SCOLETOMA HEBES	
	SCOLOPLOS ARMIGER	
	SPHAEROSYLLIS SP.	
	SPIO FILICORNIS	
	SPIO LINICOLA	237.5
	SPIO SETOSA	
	SPIO SP.	12.5
	SPIO THULINI	
	SPIONIDAE	12.5
	SPIOPHANES BOMBYX	
	SPIOPHANES KROYERI	
	STERNAPSIS SCUTATA	
	SYLLIDAE	
	SYLLIS	
	(TYPOSYLLIS)ALTERNATA	
	TEREBELLIDAE	
	TEREBELLIDES ATLANTIS	

TABLE A1-11. (Continued)

GROUP	SPECIES	MEISBURGER 7 HABITAT VIII
POLYCHAETA	TEREBELLIDES STROEMI	
	THARYX ACUTUS	87.5
	TRICHOBRANCHUS ROSEUS	
	TROCHOCHAETA MULTISETOSA	
	TROCHOCHAETA SP.	
	TYPOSYLLIS SP.	
OLIGOCHAETA	OLIGOCHAETA	
GASTROPODA	ALVANIA EXARATA	
	BUCCINUM UNDATUM	
	COLUS PUBESCENS	
	COLUS SP.	
	CREPIDULA FORNICATA	
	GASTROPODA	
	LACUNA VINCTA	
	LUNATIA NEROS	
	MARGARITES HELICINUS	
	NASSARIUS TRIVITTATUS	
	OENOPOTA DECUSSATA	
	RETUSA OBTUSA	
	TURRIDAE	
POLYPLACOPHORA	ISCHNOCHITON ALBUS	
BIVALVIA	ANOMIA SP.	
	ARCTICA ISLANDICA	
	ASTARTE BOREALIS	
	ASTARTE SP.	
	ASTARTE UNDATA	
	BIVALVIA	87.5
	CERASTODERMA PINNULATUM	
	CRENELLA DECUSSATA	
	CRENELLA GLANDULA	
	CRENELLA SP.	
	HIATELLA SP.	
	LYONSIA HYALINA	
	MUSCULUS NIGER	
	MYA AREWARIA	
	MYSELLA PLANULATA	
	MYTILIDAE	
	NUCULA SP.	
	NUCULA TENUIS	50.0
	PECTINIDAE	
	PERIPLOMA LEANUM	
	PERIPLOMA SP.	12.5
	PLACOPECTEN MAGELLANICUS	
	THRACIA MYOPSIS	

TABLE A1-11. (Continued)

GROUP	SPECIES	REISBURGER 7
		HABITAT
		VIII
BIVALVIA	THYASIRA FLEXUOSA	
	YOLDIA SAPOTILLA	
	YOLDIA SP.	12.5
CIRRIPEDIA	CIRRIPEDIA	
MYSIDACEA	MYSIDACEA	
CUMACEA	CARPYLASPIS RUBICUNDA	
	DIASTYLIS ABBREVIATA	
	DIASTYLIS BISPINOSA	
	DIASTYLIS SCULPTA	
	EUDORELLA PUSILLA	
	PETALOSARSIA DECLIVIS	
ISOPODA	EDOTEA TRILOBA	
	JAERA MARINA	
	PLEUROGONIUM SPINOSISSIMUM	
	POLITOLANA COINCHARUM	12.5
	PTILANTHURA SP.	
AMPHIPODA	AEGINIINA LONGICORNIS	
	AMPELISCA MACROCEPHALA	
	AMPELISCA SP.	137.5
	AMPHIPODA	
	ANONYX LILJEBORGI	
	ANONYX SARSI	
	ARGISSA HAMATIPES	
	BYBLIS SERRATA	
	CASCO BIGELOWI	
	COROPHIIDAE	
	COROPHIUM CRASSICORNE	
	ERICTHONIUS FASCIATUS	
	ERICTHONIUS SP.	
	GAMMARUS LAWRENCIANUS	
	GAMMARUS SP.	
	HAPLOOPS SP.	
	HAPLOOPS TUBICOLA	
	HARPINIA PROPINQUA	
	HIPPOMEDON SERRATUS	
	JASSA MARMORATA	
	LEMBOS WEBSTERI	
	LEPTOCHEIRUS PINGUIS	
	LYSIANASSIDAE	
	MONOCULODES SP.	
	MONOCULODES TUBERCULATUS	
	OEDICEROTIDAE	
	PHOTIS POLLEX	
	STENOPLEUSTES SP.	

TABLE A1-11. (Continued)

GROUP	SPECIES	NEISBUR-GER 7 HABITAT VIII
AMPHIPODA	SYRRHOE CRENULATA	
	UNCIOLA INERMIS	
	UNCIOLA IRRORATA	
	UNCIOLA SP.	12.5
DECAPODA	CANCER IRRORATUS	
	PAGURUS LONGICARPUS	
SIPUNCULA	GOLFINGIA SP.	
	SIPUNCULA	
PHORONIDA	PHORONIS ARCHITECTA	37.5
BRYOZOA	ANGUINELLA PALMATA	
	BUGULA TURRITA	
	CRISIA EBURNEA	
	ELECTRA PILOSA	
	EUCRATEA LORICATA	
	HIPPOTHOA HYALINA	
OPHIUROIDEA	OPHIOPHOLIS ACULEATA	
	OPHIURA ROBUSTA	
	OPHIURA SARSI	
	OPHIUROIDEA	
ECHINOIDEA	STRONGYLOCENTROTUS DROEBACHIENSIS	
CHORDATA	CHORDATA	
ASCIDIACEA	APLIDIUM SP.	
	ASCIDIA SP.	
	CORELLA BOREALIS	
X NO. OF INDIV	TOTAL	2512.5
N PORIFERA	TOTAL	
X HYDROZOA	TOTAL	P
X ANTHOZOA	TOTAL	62.5
X NEMERTINEA	TOTAL	50.0
X NEMATODA	TOTAL	
X ARCHIANNELIDA	TOTAL	
X POLYCHAETA	TOTAL	2037.5
X OLIGOCHAETA	TOTAL	
X GASTROPODA	TOTAL	
X POLYPLACOPHORA	TOTAL	
X BIVALVIA	TOTAL	162.5
X CIRRIPEDIA	TOTAL	
X MYSIDACEA	TOTAL	
X CUMACEA	TOTAL	
X ISOPODA	TOTAL	12.5
X AMPHIPODA	TOTAL	150.0
X DECAPODA	TOTAL	
X SIPUNCULA	TOTAL	
X PHORONIDA	TOTAL	37.5
X BRYOZOA	TOTAL	
X OPHIURDIDEA	TOTAL	
X ECHINOIDEA	TOTAL	
X CHORDATA	TOTAL	
X ASCIDIACEA	TOTAL	
NO. OF TAXA	ZTOTAL	35.0

TABLE A1-12. DOMINANT FISH SPECIES[a] AND LOBSTERS IN TRAWLS CONDUCTED IN AN AREA JUST WEST[b] OF THE MWRA PROPOSED OUTFALL BY MASSACHUSETTS DIVISION OF MARINE FISHERIES, 1991-92.

COMMON NAME	5/91	5/92
FISH	**PERCENT COMPOSITION**	
Ocean pout	35	15
Longhorn sculpin	21	19
Winter flounder	19	33
Atlantic cod	17	10
Yellowtail flounder	7	16
All other spp.	1	7
Total	100%	100%
	ABUNDANCE	
Total # Indiv.	655	685
Trawl length (min)	20	13
Total CPU[c] est. (20 min)	655	1054
AMERICAN LOBSTER (Count)		
Total # Indiv.	17	60
Total CPU[c] est. (20 min)	17	92

[a]Those making up > 10% of the catch
[b]Approx. 42°23' N, 70°49' W ("Rosie's Hole")
[c]Catch Per Unit

TABLE A1-13. MIXING ZONES FOR DISPOSAL AT IN-CHANNEL LOCATIONS.

	TYPICAL			WORST CASE		
SITE	MAXIMUM LENGTH (m)	MAXIMUM WIDTH (m)	AREA (acres)	MAXIMUM LENGTH (m)	MAXIMUM WIDTH (m)	AREA (acres)
Mystic River	285	125	8.3	480	185	12.5
Chelsea River	300	95	6.4	1190	140	30.0
Inner Confluence	285	80	4.8	590	140	14.7

Note: analysis includes effects of simultaneous dredging in the vicinity of disposal operations; PCB analysis assumes disposal of the Mystic River sediments (worst case for PCBs) in Mystic

TABLE A1-14. RESULTS OF POLLUTANT TRANSPORT MODELLING FOR IN-CHANNEL DISPOSAL SITES.

PARAMETER	MAXIMUM 29-DAY CONCENTRATION	AMBIENT CONCENTRATION	WATER QUALITY STANDARD[1]
TSS	39 mg/L	0-19 mg/L	---[2]
Mercury	3.2 ng/L	4 ng/L	25 ng/L
Copper	5.7 ng/L	300 ng/L	2900 ng/L
Total PCBs	0.7-11.0 ng/L[3]	7 ng/L	30 ng/L
Naphthalene	86 ng/L	04. ng/L	2,350,000 ng/L[4]

[1] chronic level unless otherwise stated; Cu, chronic level = acute level
[2] no water quality standard established
[3] higher value caused by Mystic River sediments (25% of total silt to be disposed)
[4] actute level, no chronic level established

TABLE A1-15. RESULTS OF POLLUTANT TRANSPORT MODELLING AT SPECTACLE ISLAND CAD

PARAMETER	MAXIMUM 29-DAY CONCENTRATION	AMBIENT CONCENTRATION	WATER QUALITY STANDARD[1]
TSS	15 mg/L		---[2]
Mercury	0.6 ng/L	4 ng/L	25 ng/L
Copper	1.1 ng/L	300 ng/L	2900 ng/L[4]
Total PCBs	0.1-0.2 ng/L[3]	7 ng/L	30 ng/L
Naphthalene	24 ng/L	0.4 ng/L	2,350,000 ng/L4

[1] chronic level unless otherwise stated
[2] no water quality standard established
[3] higher value due to Mystic River sediments (25% of total silt to be disposed)
[4] acute level, no chronic level established

TABLE A1-16. SEDIMENT CHARACTERISTICS IN VICINITY OF PROPOSED SUBAQUEOUS CONTAINMENT SITES B AND E AND WINTHROP HARBOR CONTAINMENT SITE.

	LOCATION		
	SUBAQ B[b]		SUBAQ E[c]
PARAMETER[a]	ST1-14	ST1-15	B-33-L
% Silt/Clay	3	5	--
As	3.3	4.8	9
Cd	0.6	1.0	4.9
Cr	12.8	30.7	57
Cu	10.5	47.7	105
Pb	11.6	32.7	62
Hg	0.06	0.22	0.34
Ni	16.2	30.6	18
Zn	40.4	81.7	142
PCBs	TR	TR	<0.05
% Volatile solids	1	1	--
Oil and grease	<100	600	0.40
Total petroleum hydrocarbon	<100	400	--
% Total organic carbon	0.2	0.3	--

[a] Results in mg/kg (ppm) unless otherwise noted; all values relative to dry weight.
[b] Cortell, 1990b
[c] Massport, 1990
[d] Army Corps of Engineers, (NED) 1992

TABLE A1-17. RESULTS OF POLLUTANT TRANSPORT MODELLING AT SUBAQUEOUS B.

PARAMETER	MAXIMUM 29-DAY CONCENTRATION	AMBIENT CONCENTRATION	WATER QUALITY STANDARD[1]
TSS	7 mg/L		---[2]
Mercury	0.3 ng/L	4 ng/L	25 ng/L
Copper	0.6 ng/L	300 ng/L	2900 ng/L[4]
Total PCBs	0.06-0.3 ng/L[3]	7 ng/L	30 ng/L
Naphthalene	12 ng/L	0.4 ng/L	2,350,000 ng/L[4]

[1] chronic level unless otherwise stated
[2] no water quality standard established
[3] higher value due to Mystic River sediments (25% of total silt to be disposed)
[4] acute level, no chronic level established

TABLE A1-18. RESULTS OF POLLUTANT TRANSPORT MODELLING AT SUBAQUEOUS E.

PARAMETER	MAXIMUM 29-DAY CONCENTRATION	AMBIENT CONCENTRATION	WATER QUALITY STANDARD[1]
TSS	9 mg/L		---[2]
Mercury	0.3 ng/L	4 ng/L	25 ng/L
Copper	0.7 ng/L	300 ng/L	2900 ng/L[4]
Total PCBs	0.07-0.3 ng/L[3]	7 ng/L	30 ng/L
Naphthalene	14 ng/L	0.4 ng/L	2,350,000 ng/L[4]

[1] chronic level unless otherwise stated
[2] no water quality standard established
[3] higher value due to Mystic River sediments (25% of total silt to be disposed)
[4] acute level, no chronic level established

TABLE A1-19. MAXIMUM CONCENTRATION (mg/l) OF COPPER AND SILT/CLAY IN THE WATER STRATIFIED COLUMN AT THE BOSTON LIGHT SHIP DISPOSAL SITE UNDER SUMMER CONDITIONS ESTIMATED BY THE ADDAM'S MODEL FOUR HOURS AFTER A SINGLE DUMP OF 2,000 CU. YDS.

	MAX. CONCENTRATION OUTSIDE THE MIXING ZONE[a]		MAX. CONCENTRATION WITHIN THE MIXING ZONE		
DEPTH (ft)	COPPER[b]	SILT/ CLAY[c,d]	COPPER	SILT/ CLAY	SILT/CLAY CLOUD DIA. (ft)
1	0.00036	5.2	0.00035	5.2	
50	0.00035	5.5	0.00036	5.5	
108	0.00051	NE	0.00066	NE	
145	0.00038	6.3	0.00042	7.9	2738

[a]Mixing zone = Disposal site boundary
*WQ criteria, Copper = 0.0029 Mg/L
[b]Background, Copper = 0.00035 Mg/L
[c]Background, Total Suspended Solids = 4.5 mg/L
[d]Conc. silt/clay = Background TSS (4.5) + concentration on grid above background

TABLE A1-20. UTILITIES LOCATED WITHIN TRIBUTARIES PROPOSED FOR DEEPENING.

UTILITIES	DEPTH (MLW)
MWRA Water Tunnel (McArdle)	38.5
N.E. Telephone Cable	45.0
Boston Edison Electrical Cable	40.0
City of Boston Bridge Cable (McArdle)	45.0
City of Boston Fire Alarm Cable	45.0
MWRA Water Tunnel (to be removed)	35.1
MWRA Sewer Siphon	50.8
MWRA Water Tunnel	45.0
Boston Gas Siphon	40.3
MBTA Electrical Cable	40.0

TABLE A1-21. AVERAGE CONCENTRATION OF TOTAL ORGANIC CARBON AND TOTAL PETROLEUM HYDROCARBONS. MASSPORT DREDGING PROJECT.

SITE	AVG. CONC. TOC (%)	AVG. CONC. TPH
Army Base 1-3	3.9	3233
Army Base 4-9	2.7	2390
Boston Edison Intake	5.4	2851
Conley 11-13	4.1	1310
Conley 14-15	3.1	3127
Distrigas	6.6	4393
Eastern Minerals	3.6	2425
Boston Edison Barge Berth	10.2	3650
Gulf Oil	1.7	1820
Moran	5.6	3035
Mystic 2, 49, 50	2.4	2175
Mystic Pier 1	3.7	4640
North Jetty	3.1	2627
Prolerized	5.0	3970
Revere Sugar	4.5	3000

TABLE A1-22. COMPARISON OF AVERAGE LEAD AND CHROMIUM CONCENTRATIONS (MG/L) WITH MASSACHUSETTS DEP BULK SOIL CONCENTRATIONS (MG/L) FOR TCLP ANALYSIS. MASSPORT DREDGING PROJECT.

SITE	MASS DEP BULK SOIL LIMIT FOR CR AND PB (MG/KG)	AVERAGE BULK SEDIMENT CONC. (MG/KG) CR	PB	EPA REG. LEVEL FOR CR & PB (MG/L)	TCLP RESULTS (MG/L) CR	PB
Army Base	100	146	111	5	ND	0.33
Boston Edison Intake	100		103	5		
Conley	100	188	140	5	ND	0.29
Distrigas	100	149	657	5	ND	0.41
E. Minerals	100	242	221	5	ND	0.23
Boston Edison Barge Berth	100	173	175	5	ND	0.35
Gulf Oil	100	135	156	5	ND	0.17
Moran	100	100	350	5	0.07	0.26
Mystic Piers	100	164	299	5	ND	0.31
North Jetty	100	189	321	5	ND	0.46
Prolerized	100	151	476	5	ND	0.47
Revere Sugar	100	178	501	5	0.16	0.39

TABLE A1-23. CONCENTRATION OF SODIUM AND CHLORIDE FOR MASSPORT DREDGING PROJECT.

SITE	SODIUM (MG/KG)	CHLORIDE %
Conley	3250	1.9
Army Base	3600	1.8
Moran	5930	2.1
North Jetty	5560	1.8
Eastern Minerals	40140	1.6
Mystic Pier	6560	2.0
Gulf Oil	10650	1.1

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